C.2.2 Baseline Data Survey Results

C.2.2.1 Atmospheric Environment

C.2.2.1.1 Ambient Air Quality

In order to evaluate the ambient air quality in the project area CCET measured and analyzed ambient air quality at 10 points in November 2000:

- A1: Tien Nga lake in Lac Vien ward
- A2: Du Hang lake
- A3: Proposed sludge disposal place in Trang Cat landfill
- A4: Sen lake, in front of Le Chan People's Committee
- A5: Concrete Tre birdge at Da Nang road
- A6: Next to Dinh Hoat transformer station
- A7: Next to Rao bridge along Hai Phong- Do Son road
- A8: Vinh Niem tidal gate
- A9: May Den tidal gate
- A10: So Dau tidal gate

Sampling points are shown in Figure C.2.2.1 and detailed analysis results are presented in Table C.2.2.1.

Assessment was made according to Vietnamese Standard TCVN 5937-5938, 1995. In all locations the concentrations of air indicators are much lower than the permissible level, except the dust concentration which exceeds in some place the standard limits.

Limit of Basic Indicators of Ambient Air (mg/m3)

Indicator	Averaging 1 hour	Averaging 8 hours	Averaging 24 hours	Vietnamese Standard -1995
CO	40	10	5	TCVN-5937
NO_2	0.4	-	0.1	TCVN-5937
SO_2	0.5	-	0.3	TCVN-5937
H_2S	0.008	-	0.008	TCVN-5938
Pb	-	-	0.005	TCVN-5937
Suspended dust	0.3	-	0.2	TCVN-5937

SO_2: The average value in 24 hours varied between 0.0016mg/m^3 - 0.0179 mg/m^3. The permissible level is 0.300 mg/m^3. The analyzed concentrations were quite stable. At points No 4, 5, 6, 9, the SO_2 concentration was higher than in other locations because the impacts of vehicles travelling on the road. None of the values exceeded the standard limits.

NO_2: The average value in 24 hours varied between 0.001mg/m^3 - 0.0346 mg/m^3. The permissible level is 0.100 mg/m^3. The measured NO_2 concentrations were quite stable and none exceeded the standard limits.

CO: The average value in 24 hours varied between 0.24 mg/m^3 - 4.04 mg/m^3. The permissible level is 5 mg/m^3. The measured CO concentrations were quite stable and none of values exceeded the standard limits.

H_2S: The average value in 24 hours varied between 0.0005 mg/m^3 - 0.0053 mg/m^3. The permissible level is 0.008 mg/m^3. The measured H_2S concentrations were quite stable and none of values exceeded the standard limits.

The average value of suspended particles in 24 hours varied between 0.063 mg/m^3- 0.892 mg/m^3. The permissible level is 0.002 mg/m^3. Only at So Dau gate the dust concentrations were lower than the standard limits, in other locations the dust concentrations were higher than the permissible levels. The major source for dust was traffic.

Lead in dust: The average value in 24 hours varied between 0.00008 mg/m^3 - 0.00062 mg/m^3. The permissible level is 0.005 mg/m^3. The measured concentrations were many times below the standard limits. Lead content in the air is generated from internal combustion chamber. Therefore, the major lead source is form engines of traffic vehicles. The measuring point in Concrete bridge (No5 Cau Tre) had the highest lead value of 0.00062 mg/m^3 .

The results are typical for the dry season. According to the analysis results, the air quality in this area is generally good, except at locations such as Xi Mang bridge, and Da Nang road where concentrations of dust and other substances were higher than the permissible level due to impacts of traffic.

C.2.2.1.2 Noise

The noise measuring points were the same than air quality measurement points.

The noise measuring was done according to Vietnamese Standard TCVN-5965-1995. Noise was measured at 4 points during 24 hours in November 2000. Each sampling lasted 6 hours, and during each sampling noise was measured 3 times each lasting for 10 minutes.

Collected data was compared with Vietnamese Standard TCVN 5949-1995.

Standard Limits (dB) for Public and Residential Areas

Area	Time		
	6h-18h	18h-22h	22h-6h
Area need quiet atmosphere: Hospital, library, sanatorium, kindergarten, school	50	45	40
Residential area: Hotel, house, offices	60	55	45
Commercial area, services	70	70	50
Production units in the vicinity of residential area.	75	70	50

Average Noise Results (dB) in November 2000

Point	Observation 1		Observation 2		Observation 3		Observation 4	
A 1	57.9	47.75	85.75	71.75	72.85	61.85	77.15	62.9
A 2	55.9	49.8	79.4	70.9	69.3	60.4	77.2	67.3
A 3	55.9	50.1	62.9	55.1	58.4	51.5	67.2	54.5
A 4	71.4	57.9	88.0	82.0	80.6	70.7	79.9	73.9
A 5	80.4	63.7	88.2	77.6	74.6	63.4	79.1	70.9
A 6	73.9	60.9	88.0	78.9	74.1	67.8	80.9	75.0
A 7	78.9	63.1	83.0	77.8	74.1	61.2	77.7	65.7
A 8	53.9	47.9	62.8	58.8	59.4	55.1	59.2	54.9
A 9	79.4	66.9	89.5	82.2	81.1	66.6	81.4	74.1
A 10	50.9	46.8	64.3	59.8	58.4	53.8	57.7	52.4

Source: Measuring data 3/2000. CERECE

Results show that there were differences between measuring locations. The noise level was the highest along the streets and the lowest in faraway points e.g. in A8 Vinh Niem tidal gate. In general, the noise values are below the standard limits.

C.2.2.2 Aquatic Environment

C.2.2.2.1 An Kim Hai Channel

An Kim Hai Channel is an irrigation system serving for agriculture in some areas of Hai Duong and Haiphong City. An Kim Hai Channel receives water from Rang river through Bang La and Quang Dat gates and from Kim Mon river through Kim Son gate. Currently, the channel is mainly used as drainage and sewerage channel for the City. Wastewater is discharged to the channel from the several outlets. There are 4 outlets in An Duong area, 6 in Niem Nghia, 2 in Du Hang-Lach Tray section and 3 in Lach Tray-Kieu Son section (Figure C.2.2.2). The volume of discharge varies during the day, being the highest in the morning 6-8 am and in the evening 4-7 pm. Due to the damage of Nam Dong gate almost all wastewater amount is discharged to Phi Truong gate then to the Cam River. The water flow measured at 10 am on 23 November 2000 was 6.5m^3/minute at Ha Doan section.

The channel is gently sloped and meandering and the channel width varies 15-20m. The flow rate is low, of 0-0.524m^3/s.

The tide regime is controlled by tidal gates. In rainy season, Bang Lai, Quang Dat, and Trung Trang tidal gates are all closed to prevent flood. Major gates such as Cai Tat and Kinh Cong are open sometimes to intake water during dry season while others are closed to prevent salinity intrusion. There is both inflow and outflow of water through this system.

C.2.2.2.2 Surface Water and Groundwater Quality

Three type of water samples were taken: 11 surface water samples from An Kim Hai Channel, 2 samples from ponds in Phuong Luu area and 2 groundwater samples from Phuong Luu area.

An Kim Hai Channel sampling points, Figure C.2.2.3:

- AKH 1: An Duong ward
- AKH 2: Tran Nguyen Han ward, 100 m from Chan Nguyen Han road
- AKH 3: Footbridge in Soi hamlet
- AKH 4: Hang Kenh bridge
- AKH 5: Van Cao gate
- AKH 6 : Opposite of SOS Children village
- AKH 7: Field in Dong Hai commune
- AKH 8: Hamlet 3, Dong Hai commune
- AKH 9: Xa bridge, Nam Hai commune
- AKH 10: Cemetery in Nam Hai commune
- AKH 11: Nam Dong gate

The quality of pond water was assessed according to surface water standard TCVN 5942-1995 and water quality of An Kim Hai Channel according to TCVN 5945-1995 because the channel is used for wastewater discharge. TCVN 5944-1995 was applied for groundwater assessment.

The results of 11 surface water samples taken along An Kim Hai Channel indicated that the three first channel sections in Tran Nguyen Han, Xom Soi, and Dong Quoc Binh were polluted (Table C.2.2.2). The last sections of the channel were only slightly polluted.

- BOD_5 was 3 times higher than the permissible level (sample AKH 2)
- COD exceeded about 3 times the tolerable limit (sample AKH3)
- Total N was on the standard limit (sample AKH2 and AKH3)
- Fe was 2 - 15 times higher than the standard limit (sample AKH2 and AKH4)

Phuong Luu surface water sampling points were as follows: (Figure C.2.2.3)

- AKH 12: drainage ditch of Phuong Luu subvillage- Dong Hai commune
- AKH 15: pond in hamlet 1- Phuong Luu subvillage- Dong Hai commune

The surface water quality in Phuong Luu was still ensured, all indicators were lower than the permissible level (Table C.2.2.3).

Phuong Luu groundwater sampling points were as follows: (Figure C.2.2.3)

- AKH 13: Drilled well water at family Nguyen Van Thanh- hamlet 1- Phuong Luu subvillage- Dong Hai commune
- AKH 14: Dug well water: Family Nguyen Dinh Tuan -hamlet 3- Phuong Luu subvillage- Dong Hai commune

Compared to TCVN 5944-1995, the groundwater in this area indicated biological pollution. The number of coliform bacteria was 83-126 times higher than the permissible level, and number of fecal coliform 100-180 times higher than the standard limits (Table C.2.2.4).

C.2.2.2.3 Sediment Quality

Twelve sediment samples were taken from the same points from An Kim Hai Channel as water samples, and one sediment sample was taken also from drainage ditch in Phuong Luu, Figure C.2.2.3.

There is no Vietnamese sediment standard available, and therefore European standards are used for assessment.

Permissible Heavy Metal Content in Sediment

Name	***Sweden***	***Germany***		***Europe***		
Receptor	Sludge	Soil	Sludge	Soil	Sludge	
Unit	mg/kg	Mg/kg	mg/kg	Mg/kg	mg/kg	mg/kg
Cd	30	3	20	1-3	20-40	1.5(1)
Cr	1000	100	1200	1-3	20-40	1.5(2)
CO	100					
Cu	1000	100	1200	50-140	100-1750	
Pb		100(*)	2000(**)			
Hg		2(3)	25(4)			
Ni	10	50	200			
Zn	3000(5)	300(6)	3000(7)	150-300(*)(7)	2.5-4(***)(7)	

(*) Government proposal	(1) for over 10 years	(5) Contained in dry sludge
(**) Unit g/ha.a	(2) Transported in 1 ha.a	(6) Contained in soil
(***) Unit g/kg	(3) For dry soil	(7) Evenly spreading
	(4) For disposed sludge	

Source: Environmental Handbook Volume III-1995, German Economic Cooperation and development Ministry

The results of samples taken in January 2000 are shown in Table below. The results from November 2000 are presented in Table C.2.2.5.

Analysis Result of An Kim Hai Channel Sediment Samples

Items	Unit	AnKimHai1	AnKimHai 2
Humidity	%	35.4	36.1
Total P	mg/kg	41.2	385
Total N	mg/kg	82.5	725
Oil	mg/kg	5.2	4.4
As	mg/kg	0.22	0.18
Hg	mg/kg	0.19	0.15
Cd	mg/kg	0.0008	0.0006
Pb	mg/kg	0.0108	0.0121
Cr	mg/kg	0.007	0.0074
Cu	mg/kg	0.0093	0.0102
Ni	mg/kg	0.0041	0.0038
Zn	mg/kg	0.0152	0.0118

Source: Measuring data 1/2000. CERECE

Concentrations of heavy metal in sediment were low, but the concontrations of organic substances, especially BOD was very high.

C.2.2.3 Human Environment

C.2.2.3.1 General

Socio-economic survey was carried out by CCET in November 2000. The survey consisted of two parts:

1) General overview of the area along An Kim Hai Channel through interviewing phuong authorities and related agencies
2) Interview of 100 households along An Kim Hai Channel and proposed Phuong Luu Lake

The summaries of background data and detailed results of the socio-economic survey are presented in Table C.2.2.6. and 2.2.7.

C.2.2.3.2 Land Use and Infrastructure

Area along An Kim Hai Channel is divided into five section, the first three starting from An Duong are mainly residential and small industry areas, the fourth section from Kieu Son to Ha Doan is both residential and agricultural area and the last section is agricultural area. According to SADCO's calculations there are over 1000 households living next to the channel.

- Section 1 from An Duong to Du Hang: 386 households
- Section 2 from Du Hang to Lach Tray: 275 households
- Section 3 from Lach Tray to Kieu Son: 270 households
- Section 4 from Kieu Son to Ha Doan: 107 households
- Section 5 from Ha Doan to Nam Dong: 6 households

According to the socio-economic survey 90% of population has access to piped water and 10% has UNICEF hand pump. 77% of houses are not connected to the sewerage system. Wastewater from these houses are mainly discharged to the channel (94%) and 2% of these households leave the wastewater penetrated into the ground. 92% of population have private toilets of which almost all are flush toilets. 72 % (65 pieces) of these households have septic tank, but 22% discharge the wastewater from toilet straight to the channel. From houses having septic tank effluent is discharged mostly to channel (66%) or sewer (26%). Septic tanks are emptied seldom, every five year 12%, when needed 11%, and from 65 septic tanks 44 have never been emptied (68%).

URENCO collects solid waste from 49% of households. 19% of households throw their solid waste to the channel and 5% just on the road. Only 18 % of households separate their waste.

Households living just next to the channel banks suffer from flood during heavy rain, because channel is full of garbage and sediment.

C.2.2.3.3 Population, Education, Housing and Household Economy

Population along the channel has mostly primary and secondary education (41% and 37% respectively). Only 11% have university education, most of them living in section from An Duong to Lach Tray.

The main occupations in the area are as follows:

- Civil servants 12%
- Manual worker 11%
- Small business dealing 9%
- Housewife 5%
- Businessman 4%
- Worker 4%

The population in section from An Duong to Du Hang are mainly state workers and businessman, manual workers in this section also account for the highest proportion. Unemployment rate in section 3 (from Lach Tray to Kieu Son) is the highest (9%).

The average land area for each household is 125 m^2, the smallest being 28 m^2 and the largest 900 m^2. 72% of the households has land use entitlement, 8% belongs to the State. 17% of households own agriculture or aquaculture area. Land encroachment is the most typical feature of the area. The two banks of the channel have been reclaimed for housing and subsidiary structures. In sections 2 and 3 (from Du Hang to Kieu Son) there are no maintenance roads and especially section from Vu Chinh Thang street to Dong Vai ward and from Hang Kenh to Van Cao street it is difficult to reach the channel.

Houses in the area were built about 10 years ago. Houses with private subsidiary structure account for 72 %, semi-solid house 5% and temporary house 2%. Private people own 90% of houses. The City has issued legal document for removal of encroached houses. However, the enforcement has been delayed since almost all of encroached households are in slum area, thus, creating difficulty for removal plans.

The average monthly income of households is 1,059,700 VND from the following sources:

- Private business 48%
- Pension 36%
- Agriculture and aquaculture 5%
- State salary 18%
- Others 16%

According to the survey results, the living standard of local residents is as follows:

- Very poor 2%
- Poor 23%
- Moderate 56%
- Well-off 16%
- Rich 3%

The results show that the living standard of local resident is on moderate level. However, this level is lower than the average of the city.

C.2.2.3.4 Health Status and Services

Within the framework of this project, survey results of Military Medical Institute – Hai Phong Center for Preventive Health Care has been used. This survey concentrated on some typical wards in the project area, namely Lach Tray ward in Ngo Quyen district and Tran Nguyen Han ward in Le Chan district.

Indictors of Community Health and Common Diseases among Children under 1 Year Old

Indicator (in 1000 people)	Lach Tray- Ngo Quyen			Tran Nguyen Han- Le Chan		
	1998	1999	6 first months 2000	1998	1999	6 first months 2000
Dead number of children < 1 years old	0	0	0	6.36	6.84	0
Dead number of children < 5 years old	0	0	0	1.04	1.04	0
Dead number of expecting mother	1 ca	0	0	0	0	0
Birth rate	12.50	12.4	5.2	14.45	12.41	0
Dead rate	3.70	5.2	2.5	5.10	5.2	0
Population growth rate	8.80	7.2	2.7	9.35	7.2	0
Rate of newly-born baby <250g	3 ca	2	2	31.84	27.39	38.46
Rate of household use clean water	1000	1000	1000	960	1000	1000
Rate of household use sanitary toilet	820	820	870	870	900	970
Diseases of children <1 year old						
- Dysentery	0.68	0.98	0.78	1.28	0.94	0.68
- Acute respiratory disease	13.63	13.82	4.9	0.92	0.68	0.69
- Malnutrition	2.94	2.25	1.76	0.46	0.34	0
- Vitamin lack	0.98	0.88	0.58	0	0	0
- Eye dry	0.98	0.88	0.58	0	0	0
- Measles	0	0	0	0	0	0
- Others: polio, tetanus	0	0	0	0	0	0

Source : Military Medical Institute-Hai Phong Preventive Healthcare Centre, 7-8/2000

Disease Rate in Lach Tray and Tran Nguyen Han Phuongs

Disease by 1000 people	Lach Tray – Ngo Quyen			Tran Nguyen Han- Le Chan		
	1998	1999	6 first months 2000	1998	1999	6 first months 2000
Respiratory disease	14.12	14.31	6.86	11.58	12.07	12.25
Alimentary tract disease						
- Gastritis, duodenitis	1.47	1.56	0.78	-	-	-
- Chronic caccumitis	0.68	0.78	0.68	-	-	-
Earache, Rhinitis, angine	15.20	16.18	5.88	26.87	31.68	17.78
Flu	19.61	19.22	8.53	100.92	130.01	123.97
Toothache	1.56	8.33	7.84	-	-	-
Heart disease Hypertension	4.90	4.80	2.94	-	-	-
Rheumatism	9.80	11.76	4.90	-	-	-
Anemia disease	14.90	14.51	6.86	-	-	-
Social diseases.						
- Tuberculosis	10 ca	12	12	1.2	1.2	0.77

- Malaria	9	3	2	0.25	0.24	0.24
- Leprosy	-	-	-	1.0	1	1
Mental disease	0.98	0.98	0.98	-	-	-
Nervous depression , polio	2 ca	2	2	-	-	-
Gynecological disease	9.8	11.37	7.84	15.14	17.30	9.0
Occupational diseases	-	-	-	-	-	-
Accidents (traffic, occupation, daily work)	2.94	3	1.37	-	3.1	-
Suicide	-	2	-	-	-	-

Source：Military Medical Institute - Hai Phong Preventive Healthcare Centre, 7-8/2000

Respiratory diseases account great portion of diagnosis of all diseases. Alimentary tract diseases represent a moderate level. Dangerous infectious diseases among children are in low level, especially if there had been vaccination against the diseases the infection rate is very low or almost zero.

Impacts of Wastewater on Community Health

Negative impacts	Lach Tray- Ngo Quyen (%)	Tran Nguyen Han- Le Chan (%)
Solutions applied in flood		
- Wading	93	83
- Wait for water recede	17	13
- Others.	-	30
Impact on health		
- Very unpleasant	90	43
- Unpleasant	20	33
- Moderate	3	20
- No impacts	-	-
Nuisances		
- Bad smells	100	87
- Waste, littering	93	43
- Flies, mosquitoes	83	33
- Aesthetics loss	40	27
Affecting level to health		
- Clear impacts	70	37
- Feeling of impacts	27	27
- Little or unclear impacts	10	30
Type of impacts		
- Respiratory disease	47	17
- Intestinal disease.	67	27
- Itch, dermatitis, allergy	73	40
- Vesicle	90	60
- Others.	20	30

Source : Military Medical Institute - Hai Phong Preventive Healthcare Centre, 7-8/2000

According to the results of survey of 300 households from the impacts of wastewater and flood on community health opinions of people are as follows :

- Very unpleasant: 50 – 90 %
- Unpleasant: 20 – 40 %
- No impacts: 3 – 10 %

The major nuisances are caused by bad smell (70-90%), littering, flies, mosquito etc. (30-70%) and degradation of City's aesthetic value (20-40%). Interviewed

households understood the connection between wastewater and common diseases. The interviewed people thought that wastewater is causing diseases as follows: respiratory disease (60%), intestinal disease (30%), skin diseases and allergy (40-70%).

According to the CCET survey in November 2000 the main diseases in the region are:

- Eye diseases 51%
- Diarrhea 43%
- Skin diseases 24%
- Dengue fever 3%
- Parasites 2%
- Other water related disease 4%
- Air related disease 14%

The main causes of these diseases were considered to be polluted channel and dust.

C.2.2.3.2 Environmental Awareness and Willingness to Pay

The interviewed people assessed environment to be dirty and polluted (71%). Only 9% said the environment is clean. The main causes were the pollution of the channel (91%), bad smell from wastewater (76%), flies and mosquito (62%), dust and exhausted gas from traffic (59%), and noise (69%).

Almost all of the population wanted to have their sewers connected to the public sewerage system and waste collected by URENCO. However, they did not know how much they have to pay for these services but agree to the common level as follows:

- 10,000VND/month to reduce flood in the area
- 5,500 VND/month to have wastewater treated and waste collected
- 3,000 VND to have their sewer connected to the City's drainage system

Table C.2.2.1 Air Quality

Unit mg/m^3

Measuring points	Indicator																	
	SO_2			NO_2			CO			H_2S			Suspended dust			Lead concentration in dust		
	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min
A 1	0.00604	0.00650	0.0057	0.0065	0.0077	0.0056	1.0650	1.4000	0.610	0.00161	0.00190	0.00140	1.6500	0.23400	0.11700	0.0001	0.00014	0.00008
A 2	0.00654	0.00720	0.00590	0.00408	0.00470	0.00350	1.3800	2.0000	0.7900	0.00235	0.00270	0.0020	0.3150	0.3320	0.3010	0.00024	0.00028	0.00021
A 3	0.00521	0.0056	0.00478	0.00209	0.00260	0.00160	0.76875	0.8900	0.6800	0.00159	0.00200	0.00130	0.14863	0.21400	0.0840	0.00018	0.00020	0.00016
A 4	0.04578	0.01750	0.0142	0.00828	0.00950	0.00680	2.2000	3.5600	1.4300	0.00129	0.00170	0.0009	0.59675	0.6430	0.5390	0.00026	0.00038	0.00014
A 5	0.01276	0.01370	0.01210	0.00715	0.00910	0.00590	3.05815	4.0400	2.1100	0.00120	0.00180	0.0007	0.79725	0.89200	0.72400	0.00038	0.00062	0.00013
A 6	0.01711	0.01790	0.01610	0.03019	0.03460	0.02520	2.30000	2.6300	2.0700	0.00136	0.00200	0.0007	0.47963	0.59800	0.24200	0.00036	0.00049	0.00016
A 7	0.00240	0.00290	0.00160	0.00170	0.00220	0.00100	0.63875	0.7400	0.2400	0.00078	0.00150	0.0005	0.16075	0.21800	0.09200	0.00039	0.00043	0.00034
A 8	0.00604	0.00710	0.00490	0.00303	0.00380	0.00240	1.10250	1.24000	0.96000	0.00444	0.00530	0.0033	0.10575	0.12700	0.07200	0.00022	0.00031	0.00013
A 9	0.01366	0.01590	0.01190	0.10600	0.01320	0.00890	3.31125	3.51000	3.07000	0.00117	0.00131	0.00097	0.35025	0.63500	0.12600	0.00038	0.00053	0.00013
A 10	0.00448	0.00570	0.00290	0.00328	0.00430	0.00220	0.64875	0.77000	0.5600	0.00234	0.00310	0.00160	0.09263	0.11300	0.0630	0.00020	0.00025	0.00013
TCVN 5937 - Ave. 24 h	0.3			0.1			5			0.008			0.2			0.005		
Ave.1h	0.5			0.4			40			0.008			0.3			-		

Source: Measuring results of CERECE 1/2000

Table C.2.2.2 Water Quality of An Kim Hai Channel

No	Indicators	AKH 1	AKH 2	AKH 3	AKH 4	AKH 5	AKH 6	AKH 7	AKH 8	AKH 9	AKH 10	AKH 11	TCVN 5945 - 1995
1	Temperature (^{0}C)	17.5	17.5	18	18	18	18.3	18	18.2	19	18.5	18	40
2	Dissolved Oxygen (mg/l)	1.2	0.28	2.96	1.66	0.66	0.88	0.75	1.02	6.23	3.88	6.82	-
3	PH	7.75	7.5	7.5	7.35	7.55	7.45	7.35	7.4	7.6	7.45	7.65	5.5 - 9
4	EC (µs/cm)	1324	1616	1537	2290	2430	2050	1924	2270	1615	2950	1183	-
5	Turbidity (NTU)	17.5	347.7	62.6	65.6	82.6	104.2	54.1	39.4	59	78.5	50	-
6	Salinity (‰)	0.292	0.38	0.351	0.703	0.761	0.586	0.587	0.82	0.644	1.171	0.497	-
7	Odor	no	no	no	no	no	no	no	no	no	no	no	
8	BOD_5 (mg/l)	39.5	134.4	46.2	40.2	40	43.9	45.7	38.4	6	37.6	11.2	50
9	COD (mg/l)	76	266	80	76	72	72	76	68	16.4	62	24.4	100
10	SS (mg/l)	8.3	21	22.6	13.3	22	33	17	23	12	12	27	100
11	Total N (mg/l)	55.2	62.5	61.5	47.8	53.5	50.2	36.7	6.4	1.1	2.1	1.5	60
12	NH_4 - N (mg/l)	38.5	61.6	60.06	40.07	42.35	44.7	34.7	0.154	< 0.01	0.077	< 0.01	-
13	NO_2 (mg/l)	< 0.01	< 0.01	< 0.01	0.66	< 0.01	0.024	0.001	4.44	0.026	0.053	0.57	-
14	NO_3 (mg/l)	0.105	0.262	0.12	0.191	0.127	0.17	0.214	0.221	0.092	0.23	0.127	-
15	Total P (mg/l)	1.18	1.34	3.87	0.79	0.69	0.93	1.25	0.55	0.23	0.28	0.26	6
16	SO_4^{2-} (mg/l)	39.36	60.68	79.54	77.90	77.9	66.42	81.18	132.02	30.34	109.06	53.3	-
17	Coliform (MPN/100ml)	1300	300	200	360	670	800	720	480	80	280	60	10000

No	Indicators	AKH 1	AKH 2	AKH 3	AKH 4	AKH 5	AKH 6	AKH 7	AKH 8	AKH 9	AKH 10	AKH 11	TCVN 5945 - 1995
18	Fecal Coli (MPN/100ml)	620	160	80	180	370	488	360	200	36	100	22	-
19	Cd (mg/l)	0.0005	0.0004	0.0005	0.0005	0.0002	0.0001	0.0004	0.0001	0.0005	0.0005	0.0003	0.02
20	CN (mg/l)	0.003	0.006	0.003	0.003	0.005	0.003	0.005	0.001	0.003	0.001	0.001	0.1
21	Pb (mg/l)	0.0065	0.0095	0.002	0.003	0.0029	0.0022	0.0015	0.001	0.0025	0.0016	0.0038	0.5
22	Zn (mg/l)	0.0044	0.0095	0.0023	0.12	0.0038	0.0025	0.0031	0.0106	0.018	0.0092	0.0052	2
23	Cu (mg/l)	0.002	0.007	0.0025	0.0025	0.0025	0.0025	0.0034	0.0037	0.0047	0.0045	0.004	1
24	Cr (mg/l)	0.0089	0.0093	0.0081	0.0066	0.0088	0.0072	0.0081	0.009	0.0097	0.0051	0.0065	-
25	Cr^{VI} (mg/l)	0.0019	0.003	0.0018	0.001	0.0019	0.0017	0.0019	0.002	0.0027	0.0021	0.0015	0.1
26	As (mg/l)	0.009	0.019	0.009	0.006	0.005	0.004	0.003	0.004	0.002	0.005	0.004	0.1
27	Hg (mg/l)	0.0002	< 0.0001	<0.0001	0.0002	0.0001	< 0.0001	<0.0001	0.0002	0.0006	< 0.0001	<0.0001	0.005
28	Fe (mg/l)	0.22	75	0.36	0.25	0.28	0.74	0.34	1	0.94	0.8	1.14	5
29	Oil, grease (mg/l)	0.22	0.25	0.17	0.18	0.18	0.16	0.16	0.15	0.15	0.14	0.15	1

Source: CCET, 11/2000

Table C.2.2.3 Surface Water Quality in Phuong Luu Lake Area

STT	Indicators	AKH 12	AKH 15	TCVN 5942 - 1995
1	Temperature (^{0}C)	19	20	
2	Dissolved Oxygen (mg/l)	6.64	6.59	> 2
3	pH	7.6	7.9	5.5 - 9
4	EC (µs/cm)	1785	621	-
5	Turbidity (NTU)	347.8	55	-
6	Salinity (‰)	0.761	0.234	-
0	Odor			
8	BOD_5 (mg/l)	6.3	5.8	< 25
9	COD (mg/l)	17.6	15.2	< 35
10	SS (mg/l)	11	5	80
11	Total N (mg/l)	1	8.1	-
12	NH_4 - N (mg/l)	< 0.01	7.12	-
13	NO_2 (mg/l)	0.033	0.015	0.05
14	NO_3 (mg/l)	0.205	0.053	15
15	Total P (mg/l)	0.28	0.15	-
16	SO_4^{2-} (mg/l)	104.55	10.9	-
17	Coliform (MPN/100ml)	120	15	10000
18	Fecal Coli (MPN/100ml)	64	Nil	-
19	Cd (mg/l)	0.0006	0.0004	0.02
20	CN (mg/l)	0.007	0.005	0.05
21	Pb (mg/l)	0.0054	0.0045	0.1
22	Zn (mg/l)	0.0072	0.0018	2
23	Cu (mg/l)	0.0028	0.0048	1
24	Cr (mg/l)	0.009	0.002	-
25	Cr^{VI} (mg/l)	0.002	0.001	0.05
26	As (mg/l)	0.006	0.003	0.1
27	Hg (mg/l)	0.0002	0.0002	0.002
28	Fe (mg/l)	3.25	0.16	2
29	Oil, grease (mg/l)	0.22	0.13	3

Source: CCET, 11/2000

Table C.2.2.4 Groundwater Quality in Phuong Luu Lake Area

No	Indicators	AKH 13	AKH 14	TCVN 5944 - 1995
1	Temperature (^{0}C)	19	18.5	-
2	Dissolved Oxygen (mg/l)	5.72	6.42	-
3	PH	7.3	7.55	6.5 - 8.5
4	EC (µs/cm)	2760	4390	-
5	Turbidity (NTU)	89.7	85.3	-
6	Salinity(‰)	1.113	1.347	-
0	Odor			-
8	BOD_5 (mg/l)	14.8	14.8	-
9	COD (mg/l)	32	32	-
10	SS (mg/l)	3	5	-
11	Total N (mg/l)	5.2	2.84	-
12	NH_4 - N (mg/l)	4.813	2.46	-
13	NO_2 (mg/l)	0.855	0.345	-
14	NO_3 (mg/l)	0.0023	0.177	0.1 - 0.5
15	Total P (mg/l)	0.35	0.09	-
16	SO_4^{2-} (mg/l)	5.1	78.5	200 - 400
17	Coliform (MPN/100ml)	250	380	3
18	Fecal Coliform (MPN/100ml)	100	180	No
19	Cd (mg/l)	0.0007	0.0004	0.01
20	CN (mg/l)	0.003	0.003	0.01
21	Pb (mg/l)	0.0033	0.0015	0.05
22	Zn (mg/l)	0.0114	0.0015	5.0
23	Cu (mg/l)	0.0035	0.0027	1.0
24	Cr (mg/l)	0.008	0.009	-
25	Cr^{VI} (mg/l)	0.002	0.0026	0.05
26	As (mg/l)	< 0.001	0.005	0.05
27	Hg (mg/l)	< 0.0001	0.0002	0.001
28	Fe (mg/l)	3.5	2.6	1 - 5
29	Oil, grease (mg/l)	0.15	0.16	-

Source: CCET, 11/2000.

Table C.2.2.5 Sediment Quality in An Kim Hai Channel

No	Indicators	AKH 01	AKH 02	AHK 03	AKH 04	AKH 05	AKH 06	AKH 07	AKH 08	AKH 09	AKH 10	AKH 11	AKH 12
1	Depth (m)	1.1	0.8	1.2	0.9	1.1	1.3	1.2	1.4	1.3	1.6	1.1	0.8
2	pH	7.70	7.30	7.15	7.10	7.10	7.15	5.40	6.05	6.50	4.10	7.40	6.90
3	Humidity (%)	64.4	68.4	27.4	12.4	38.0	23.6	27.4	56.4	20.6	12.4	36.4	47.4
4	Volatile solid (g/cm^3)	182.4	298.9	132.2	174.1	152.0	112.8	118.2	194.4	74.96	130.2	118.8	91.08
5	Total solid (g/cm^3)	356.0	316.0	726.0	876.0	620.0	764.0	726.0	436.0	794.0	876.0	636.0	526.0
6	Apparent density (g/cm^3)	1.274	1.235	1.586	1.607	1.370	1.612	1.575	1.305	1.708	1.647	1.384	1.353
7	BOD (mg/kg)	6579.0	8342.0	5849.0	3277.0	6732.0	4496.0	6250.0	4130.0	3487.0	2615.0	4340.0	1476.0
8	Total N (%)	0.11	0.62	0.20	0.11	0.24	0.18	0.17	0.23	0.087	0.066	0.19	0.073
9	Total P (%)	0.362	0.625	0.375	0.337	0.475	0.487	0.387	0.375	0.500	0.400	0.425	0.550
10	Cd (%)	0.00015	0.00024	0.00008	0.00007	0.00009	0.00006	0.00006	0.00007	0.00005	0.00008	0.00006	0.00017
11	CN (%)	0.000015	0.00003	0.00001	0.000015	0.000018	0.000015	0.000035	0.000085	0.000028	0.000015	0.000028	0.00003
12	Pb (%)	0.011	0.021	0.003	0.004	0.009	0.002	0.004	0.004	0.001	0.003	0.003	0.008
13	Zn (%)	0.04	0.098	0.012	0.013	0.051	0.012	0.011	0.018	0.009	0.013	0.011	0.017
14	Total Cr (%)	0.016	0.027	0.016	0.0072	0.018	0.01	0.0096	0.0105	0.0065	0.0083	0.009	0.0115
15	Cr^{6+} (%)	0.0088	0.0062	0.0058	0.0018	0.0049	0.0013	0.004	0.0038	0.0041	0.0035	0.0037	0.0042
16	Hg (%)	0.00029	0.00095	0.00026	0.00019	0.00056	0.00024	0.00025	0.00033	0.00018	0.00013	0.00027	0.00019
17	PCB (µg/kg)	0.2	1.6	4.1	6.6	7.2	8.9	22.1	3.0	1.1	0.5	1.2	15.5

Source: CCET, 11/2000

（ダミー裏）

Table C.2.2.6 Summary of Background Data on Urban Section of An Kim Hai Channel

No	Section	Length	GENERAL DESCRIPTION	Number of household to be surveyed	Total population	GEOGRAPHICAL FEATURES	NATURAL GEOGRAPHICAL CONDITIONS			Plant	SOCIO-ECONOMIC CHARACTERISTICS			HOUSE AND RESIDENTIAL LAND					INFRASTRUCTURE AND PUBLIC			RELIGIOUS WORK		School	Hospital	Production units	ENVIRONMENT & SANITATION		COMPENSATION COST			Public opinion	Assessment of surveyor
							The channel	Water	Soil		Occupation	Incomes	Intellectual level	Land use right	Average areas	Grade IV house	One-floored house	Two-floored house	Temporary bridge	Solid bridge	Transformer station	Electric pole	Cemetery	Pagoda				Wastewater	Waste	Agricultural land	Residential land	Flower garden		
1	An Duong - Du Hang	2,295 km	This section belong to In Le Chan district (Add. of People's Committee:N°10 Ho Sen street, Tel: 031. 840814), in the territory of such phuongs as Lam Son (PC add. N°1944 Ton Duc Thang str, 031. 835 491), Niam Nghia (No280 Tran Nguyen Han str. 031.858340) , An Duong (An Duong Living quater, Ton Duc Thang), Tran Nguyen Han (No79 Ton Duc Thang str. 031.858400), Households live along the channel, there is a 1,5-2 m wide path running along seperating the bank with houses. The section Vu Chinh Thang in Tran Nguyen Han phuong can not be accessed for houses are built very close to the bank.	There are 60 households living close to the bank who illegally occupy land for housing. 176	300 over 500	Flat terrain, very dirty in rainy season because there is a earthern road.	The channel width is 5-8m long, the widest section being 8-10m, the most narrow 3-4m, the altitude is 0,2-0,5m.		1		The vegetation includes water fern	Free laborers, small business and worker.	500,000-600,000/household/month	Mostly lower secondary level		30-40m²/house 50-60 m2/house	25 0.25	15 0.35	20 0.4		8 (two if which are made by the State)		12 low voltage power poles, 1 high voltage line across the site.				1 saw mill	Direct discharge to the channel	Dispose along the bank, some places in pile		1,900,000 VND/m², 800,000 VND/m², 300,000 VND/m²		Compensation should be made according to the State regulations and the situation of household. Support the project	The people agree if suitable relocation is ensured. Box sewers is the best. The sanitation condition is very bad especially in dry season when noise, dust and unpleasant odor is prevailing. Living standard is of moderate level. The intellectual is low.
2	Du Hang Kenh to Lach Tray		This section is in the land of Du Hang commune (PC add. Du Hang Kenh comune Tel: 031.854373) From Mot bridge to Hang Kenh bridge, resident live along the channel bank, separated by a 1,5m long path. The channel section in Dong Hai runs along the National Road No5. Sub-section from Hang Kenh to Lach Tray belong to Dong Quoc Binh ward (Tel: 031.729797), Du Hang commune of Le Chan district.	287 100 45	140 450	The relief is quite flat, there are some ponds scattering from Minh Thanh factory to Co Le bridge Residential areas lie next to each other and very close the banks. Even some use bamboo stairs to encroach the channel. There is a pole of land lying next to Lach Tray bridge shilding the channel to only 1m wide.	The channel width is 12m, the widest section being 17-18m, the most narrow 5-8m. Average:10m,Widest: 17m Most narrow: 1m	Water is black,smelliby, in very bad quality.			Farming and small business Some are State worker, the rest are free laborers and small dealers.	400,000-500,000 VND/household/month 700,000-800,000 VND/household/month.	Low (Primary and lower secondary Inconsistent	Unofficial written agreement	40-50m2/house 40-50m2/house	10% 10% 10% 10%	80% 30% 80%	10% 60% 2%		4(01 solid bridge in road No5)		1 high voltage power pole 3 high voltage power poles	01 cemetery (250 tombs, of which 30 tombs needed to be re-		01 far from the channel corridor		01 food processing Minh Thanh factory Firing brigade, television station, gas filling station (these structures lie 20 m from the channel corridor)	Direct discharge to the channel Direct discharge to the channel, creating serious pollution.	Some household self collect the waste, waste incineration, digging holes for disposal. The rest discharge to the bank and the channel Direct discharge to the channel, blocking the flow in some sections.		500,000 VND/m², 1,000,000 VND/m², 100,000VND/m²		Willing to participate Compensation should be made according the law. If compensation is satisfactory, willing to remove	The environment here is seriously polluted, there are many fly, mosquito and the smell is terrible. Living standard is equal, fairly high. Most of the land owner has no illegal land use certificate. The environment is badly contaminated. The living standard is quite high.
3	Lach Tray river to Kieu Son gate		Population in this section also live very near the bank. , the channel is fully encroached, houses are built even above the channel. In the land of Dang Giang ward (PC add. Dong Khe hamlet No4, 031.844430), Dong Quoc Binh phuongs, Lach Tray ward (PC add. 93 Lach Tray str. Tel:031.845373).	309 of which 223 households encroach the channel.	1545	There are 4 small pond along the channel.	Average:10-11m,Widest: 15-16m Most narrow: 2m	Water is in very bad quality, water has black color, unpleasant odor.		There aren't many plants in this section	Most of resident work as farmer, free laborers and do small business	800,000-1,000,000 VND/household/month	Primary and lower secondary education, account for great proportion	Only 30 household own land use permit, the rest are encroachment or has unofficial written agreement	40-50m2/house	220	29 houses and 28 house foundation	21			5 high voltage power poles					01 living quarter and a 5-storied hotel	Direct discharge to the channel. Septage from sanitation work in the banks discharge directly to the channel	Waste collection service is available, however,some household still discharge to the channel					Special attention should be paid to this section due to its complexity. The environment is severely polluted. Encroachment is popular, affecting the flow of the channel
4	Kieu Son gate to Ha Doan		People live along the channel . The land next to the banks is mostly gardens. Between this section, there are 300m long bare land	130 houses along the channel 100 household in the village a bit far away from the channel	250	Flat, very dirty in rainy season	Average:12-13 m,Widest: 17 Most narrow: 1m	Water is dirty, black and smelling		Small trees like china-tree, banana, bamboo	Some are State worker, the rest are free laborers and small dealers.	500,000-700,000 VND/household/month	Intermediate (lower secondary and secondary education), Higher education is scare.	Most of the resident don't have landuse certificate	70-100m2/household	20%	60%	20%				39 low voltage power poles		There is 4 pagoda locating 7m from the bank, and is small temple			There is one small workshop making metal door	Direct discharge to the channel	Although waste collection service is available, some household still discharge to the channel	50,000VND/m2.		69,800VND/m2.	The population has no opinion	Most of population do farming, so income is low. Ah of the resident have lived here for a long time so they think that the land is residential.
5	Ha Doan to Nam Dong		This land is in territory of three phuongs: Dang Hai (PC add. Hamlet No6 Ha Cung, 031.844082), Nam Hai (PC add. Nam Hai commune, 031.870135), and Dong Hai ward. One side of the channel is occupied by house interposing with agricultural land. The other side is seperated with residential area by a road of 9 m wide	47 household close to the bank, 8-10 of which encroach land for construction	>270	There are some ponds, lakes and irrigation for agricultural production	Average:17-18m.Widest: 23.6m, Most narrow: 7-8m	Water quality in this section is better than other sections. Water can be used for irrigation and even domestic purposes.		Small trees like china-tree, banana, bamboo	Mostly farmer	400,000-500,000/household/month.	Low (primary and secondary)	Almost all of the population has no landuss permit	50-60m2/household	2	10	1	7	3	1	9 temporary pole	A 10 ha cemetery with 1000 tombs, locating 20 m fro the banks	1 small temple in the right side of the channel				Discharge directly to the channel	Collection for incinerating or disposing into the channel	50,000-100,000 VND/m².		89,900m²	Support the project	The income of population is low, unstable since flower growing depend much on weather. This location is easy for relocation because the land use is mostly farming and flower growing.

Source: CCET's socio-economic survey results 11/2000

（折込み裏）

Table C.2.2.7 Summary of Background Data from the Proposed Phuong Luu Lake Area

The proposed Phuong Luu lake is in Phuong Luu hamlet, Dong Hai commune

The proposed Phuong Luu lake is in Phuong Luu hamlet, Dong Hai commune. The site now is a field in a residential area.

The geological location is as follow:

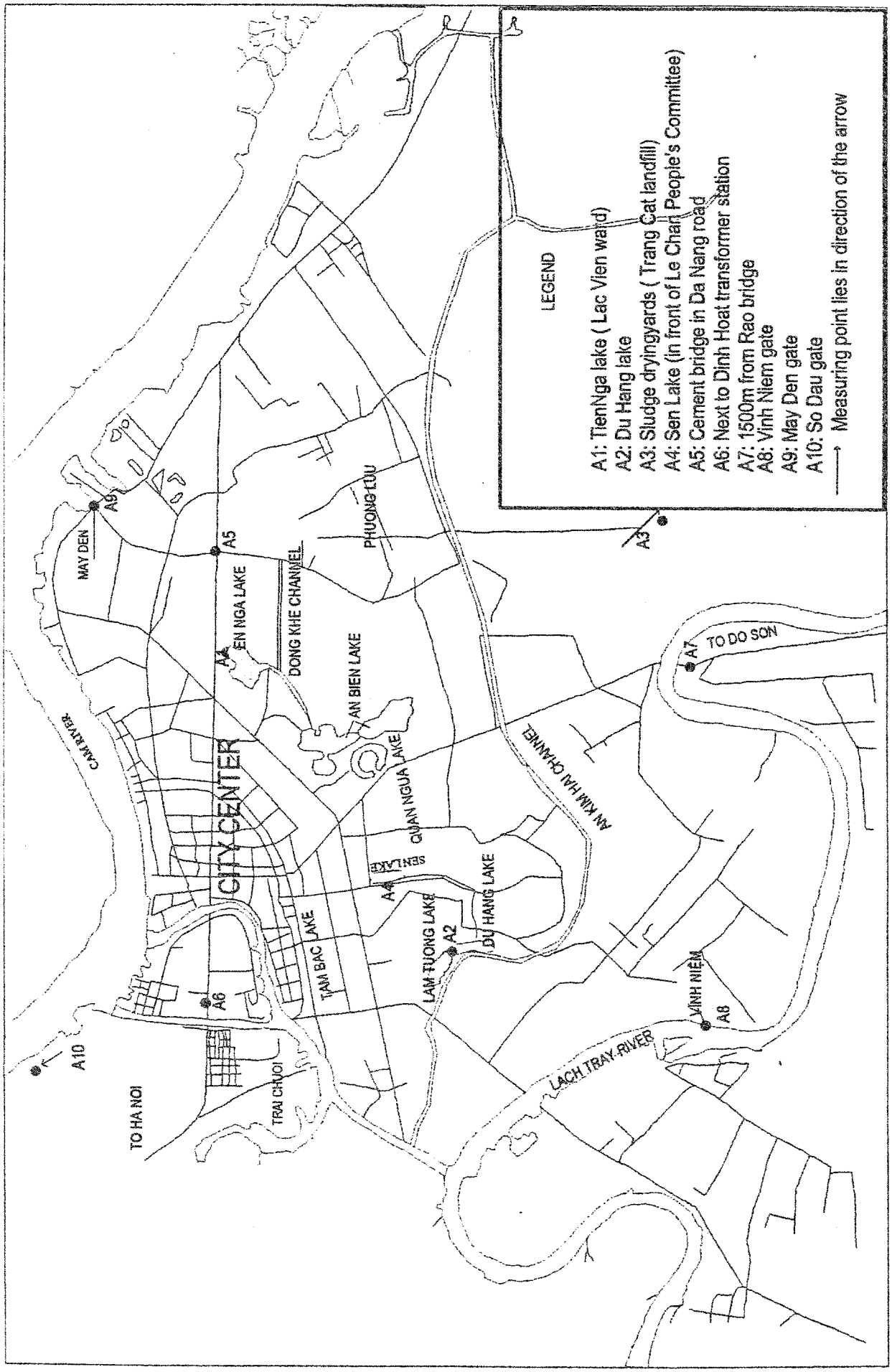
In the South is Nguyen Binh Khiem road. This is an planned area. Population is scattered. Many State offices are found here.

In the East and North is bounded with a residential area of hamlet 2, Phuong Luu subvillage, Dong Hai village.

In the West, 1000m far away, is a residential area.

Survey area	Description.	Natural characteristics			Socio-economic characteristics			Infrastructure			One floor house	Two floor house	Villa	Landuse right	Cemetery	School	Offices,Production unit	Compensation cost	Public opinion	Assessment of surveyors
		Soil	Water	Plant	Occupation	Income	Education level	Electric pole	Channel	Road										
From SOS children village to the filling station at the bend to Phuong Luu subvillage Rice field in Phuong Luu subvillage Residential area in Hamlet 2, Phuong Luu subvillage	This area is next to Nguyen Binh Khiem road, 300 m long. There are Government offices and houses interposing This area lies in the middle of the survey area. It is crossed by a irrigation ditch. This area locate in the North and East of the proposed lake.	This land is previously the flood plain. 5-6m below will be black sand layer, mangrove trees, watershed bodies such as snails, arca... Currently, land are used for		Plant are mostly rice and shrubs. Household s'garden are planted shorter trees like china-trees, banana...	Mostly farmer and gardeners, some living at road side work as Government officials.	There are one level such as: 500,000/household. 700,000/household. 1,000,000/household	Education level are not equal ranging from primary to university	5 high voltage, 11 low voltage and 7 temporary	There is concrete irrigation ditch, 0.5-0.6m wide, 2 km long flowing across the field to the South. The ditch takes water from An Kim Hai channel	There is a concrete 1.2m wide, 150 long footpath used by farmers	34	2	1	No illegal landuse permit is available	There exist one cemetery of about 12,000m2. It is divided into two parts: the first cover 1,200m2 with 130 tombs, many of which are solidly built, The second has 90 built tombs and 210 earthen tombs.	2	6	Land facing road: 1,800,000/m^2. Grade II land: 500,000-800,000m^3. Rice field: 30,000/m^2. Flower garden: 50,000m^3.	The resident wonder and complain that if all agricultural land is acquitted, how should they earn their living. However, they still agree to remove if equal replacement is supplied.	The most difficult problem is how to remove tombs and graves in cemetery of Dong Hai communa

Figure C.2.2.1 Air and noise Measuring Points



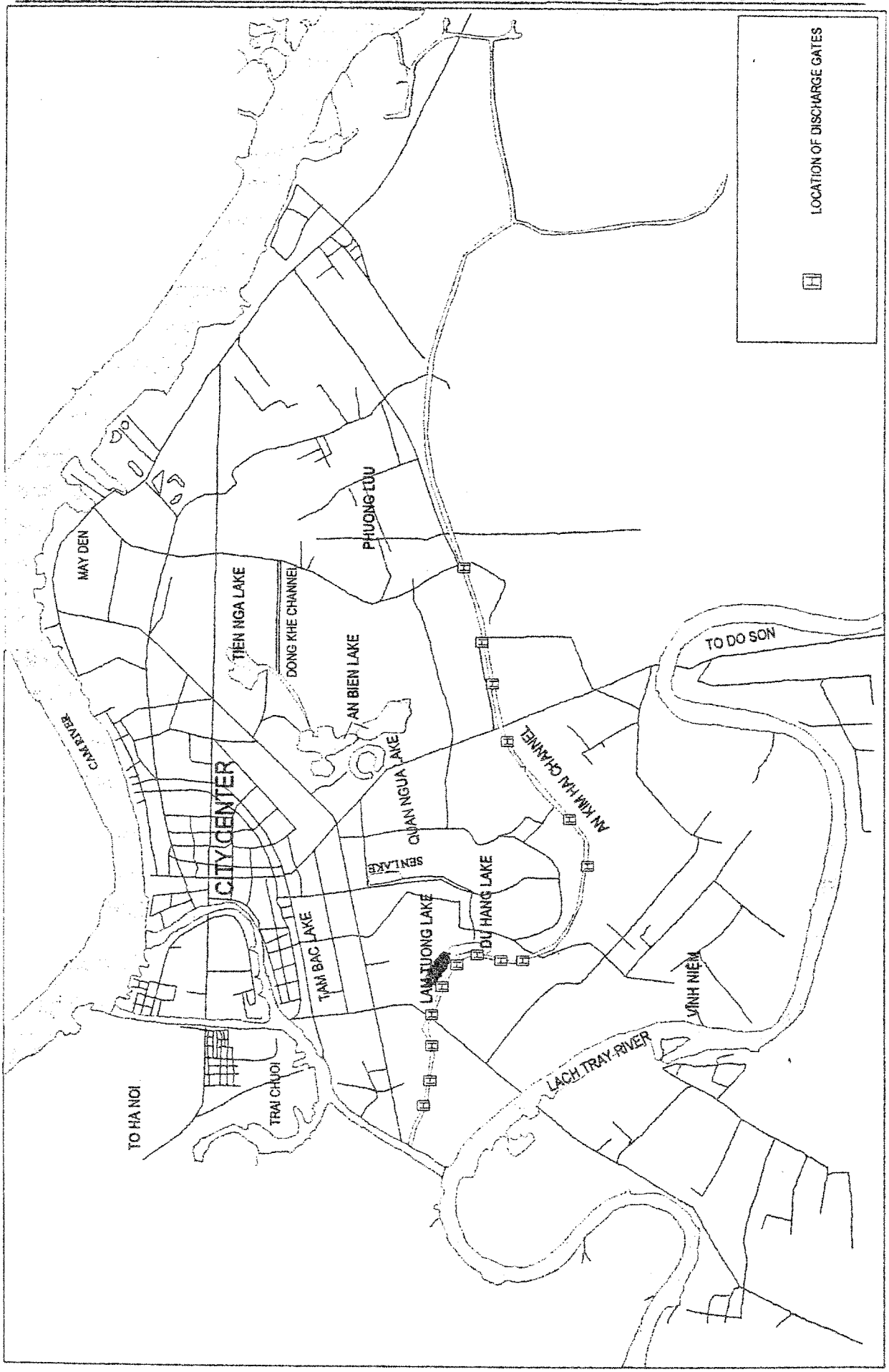


Figure C.2.2.2 Location Map of Discharge Gates to An Kim Hai Channel

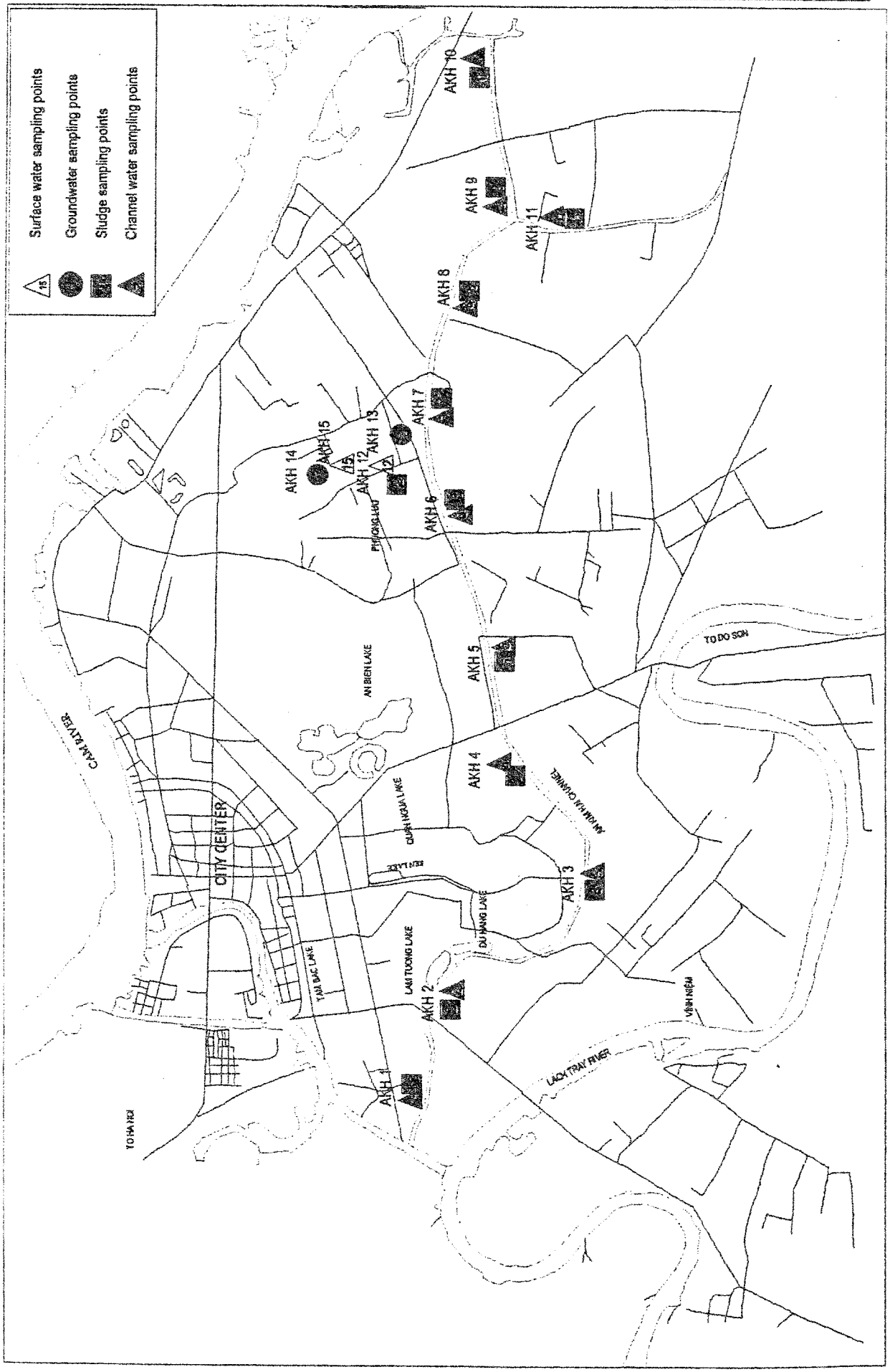


Figure C.2.2.3 Location Map of Water/Sludge Sampling Point An Kim Hai Channel and Phuong luu Lake

C.2.3 Present Drainage Status

C.2.3.1 Previous and Ongoing Studies

C.2.3.1.1 World Bank Sanitation Project

The World Bank Sanitation Project (1B Project) consists of the following system and facility measures for storm water drainage improvements:

- Cleaning, inspection and rehabilitation of existing main, secondary and tertiary combined sewer network in Class A Areas: Old City Center and NE and SW Channel systems.
- Construction of new main combined sewers in Class A Areas: Old City Center and NE Channel system.
- Rehabilitation of 2 drainage channel systems in Class A Areas: NE and SW Channel systems.
- Rehabilitation of 4 lakes in Class A Areas: NE and SW Channel systems (Tien Nga Lake, Sen Lake, Lam Tuong Lake, and Du Hang Lake).
- Rehabilitation of 3 tidal gates May Den, Vinh Niem, and Cat Bi in Class A Areas.

C.2.3.1.2 FINNIDA Projects

Proposed FINNIDA projects consist of the following system and facility measures for storm water drainage improvements.

- Rehabilitation of 3 tidal gates in Class A Areas: Hong Bang District. Rehabilitation of Ha Ly tidal gate, Thuong Ly tidal gate, and Trai Chuoi tidal gates consists of minor repairs.
- Construction of 2 storm water pumping stations in Class A Areas: Northeast and Southwest Channel systems. Storm water pumping stations are to be used to pump storm water from the Northeast and Southwest drainage systems during high tide when the tidal gates are closed. Pumping stations are located at May Den tidal gate and Vinh Niem tidal gate. Total capacity of each pumping station is 9 m3/s.

C.2.3.2 Flooding and Inundation Areas

Flooding occurs regularly in parts of the Study Area. The worst flood occurrence happen in the three urban districts. Table below presents flood areas (ha), duration (hr) and flood depths (m) for storms with 0.25 year, 0.5 year, 1 year, 5 year and 10 year ARIs. Table was based on the assessment that existing drainage system in the 3 urban districts is incapable of draining 35% of runoff from a storm duration of 6 hours with a 0.25 year, 0.5 year and 1 year ARI and for a storm duration of 8 hours with 5 year and 10 year ARIs.

Occurrences of Flooding in 3 Urban Districts

Average Recurrence Interval (ARI)	Flood Depth	Duration	Area (ha)
0.25 year	10-30 cm	2-4 hr	140
	30-50 cm	4-6 hr	30
0.5 year	10-30 cm	2-4 hr	180
	30-50 cm	4-6 hr	40
	50-70 cm	6-8 hr	10
1 year	10-30 cm	2-4 hr	250
	30-50 cm	4-6 hr	60
	50-70 cm	6-8 hr	20
2 year	10-30 cm	2-4 hr	280
	30-50 cm	4-8 hr	110
	50-70 cm	8-12 hr	40
5 year	10-30 cm	4-8 hr	320
	30-50 cm	8-12 hr	210
	50-70 cm	12-16 hr	90
	70-90 cm	16-24 hr	20
10 year	10-30 cm	4-8 hr	260
	30-50 cm	8-16 hr	310
	50-70 cm	16-24 hr	140
	70-90 cm	24-36 hr	30

C.2.4 Environmental Impacts of the Project

C.2.4.1 Approach and Methodology

All kind of construction works as well as activities related to these, will lead to certain cause (activity) and impacts on the environment. In this EIA study, we will arrange and specify both the negative and positive environmental impacts on the physical, biological and human environment caused by the rehabilitation of drainage system.

Local people's and authorities' main opinions have been recorded by socio-economic survey.

This environmental impact assessment adopts a concise format, where the linkages between environmental issues (or potential impacts), management measures (or mitigation), net effect (or residual impacts) and management information (or monitoring) are made explicitly. A comprehensive summary of these factors and their linkages is presented in the Tables C.4.7.1 – 4.7.2.

The main impacts of the proposed project are described for design phase, construction phase and operation phase. Alternative without the project implementation has been described, too.

The improvement of urban drainage, which is currently badly hampered by frequent flooding, towards a clean and healthy environment for the population of Haiphong City is essential. The overall impact of the proposed project is positive and it is an important step in improvement of drainage system improvement in Haiphong.

C.2.4.2 Without - Project Alternative

The without-project alternative is to leave the project unimplemented. In that case, the current environmental pollution will increase as follows:

- No changes or even increase of frequent floods along the upper parts of An Kim Hai Channel will create more and more human and infrastructure losses such as degradation of roads, houses, water supply system etc.
- Increase of solid waste and sedimentation in the channel will further obstruct the water flow, increase the current pollution in the channel, increase offensive odors and insects, and increase possibility of disperse water related diseases

It has been estimated in the " Master Plan for socio-economic development", that the pollution load will be doubled in the year 2010 due to increase of population and changes in ways of living. Details based on the calculations of CCET in November 2000 are as follows:

Currently:

- Water flow Q = 8.448 m^3/24hours (measured by the CCET)
- SS = 136 kg (100%)
- BOD = 189.657 kg (100%)
- N = 97.27 kg (100%)

In the year 2010, if the An Kim Hai Channel project and above mentioned master plan is not implemented, the estimated water flow will be:

- Q = 17,000m^3/24hours
- SS = 269.28 kg/24 hours (198%)
- BOD = 366.03 kg/24 hours (193%)
- N = 177.03 kg/hours (182%)

If there are not rehabilitation of An Kim Hai Channel and master plans to improve the City' environment, the physical, biological and human environment of the City will be greatly influenced. This is affecting the landscape and especially the health of Haiphong People in general and resident living along An Kim Hai Channel in particular.

C.2.4.3 Environmental Impacts during Design Phase

In design and pre-construction phase land acquisition, site clearance and resettlement will be the most important issues. According to the preliminary estimations depending on the width of maintenance margin over 1,000 – 1,300 households should be resettled, 770 houses should be relocated, and quite a number of all kind of infrastructure including electric poles, walls, water tanks, trees etc. should be removed. In proposed Phuong Luu Lake area also graves should be removed.

Site clearance will create environmental impacts and pollution such as:

- Land compensation and resettlement
- Long term and temporary impacts on households and business
- Demolition of structures
- Dust generated during removal of houses, structures and infrastructure, and material transportation
- Construction materials to be disposed such as broken bricks, concrete etc.

Land acquisition and resettlement will create temporary disturbance to people's lives. Resettlement will make people worried, causing troubles and possibly breaking the relationship between migrating and staying ones. Land acquisition will influence the assets of affected people and their income source from land.

Social security and order during land acquisition and resettlement might be disturbed. There is willingness to remove according to the schedule. However, there will be some delays due to people who do not support the project. According to interviews of 100 households living along An Kim Hai Channel most of people are willing to participate and support the project. Changing of job and business might

be difficult. Most vulnerable groups are households having small business, workers and businesses depending on the current location.

According to the preliminary estimation the number of graves in the project area is 870, most of them in Phuong Luu area. The exact number will be calculated in detailed measurement survey during the detailed design. Removal of these tombs will disturb spiritual feelings and needs attention from local authorities.

C.2.4.4 Environmental Impacts during Construction Phase

C.2.4.4.1 An Kim Hai Channel

(1) General

Major activities causing environmental pollution will be:

- Construction of embankment and maintenance roads
- Dredging of about 10 km of channel
- Removal of solid waste and water plants from channel
- Disposal of dredged sludge and other materials
- Emptying each embanked section by pumping the water to the downstream
- Closing or changing existing sewer outlets

The potential environmental impacts of the these activities are as follows:

- Dust from demolition of old structures, excavation, construction of maintenance roads, transportation of sludge, soil and broken bricks
- Noise and vibration from construction work and transportation vehicles
- Exhausted gases from construction machines and transportation vehicles during construction of embankment roads
- Release of nutrients and possible pollutants from sediment increasing pollution of water in construction site and downstream
- Gases from dredged bottom sediment (CH4, H2S, NH3)
- Stagnation of wastewater due to blocking of sewers
- Changes of irrigation and water regulation for agriculture

(2) Impacts on Air Environment

1) Air Quality

During dredging and rehabilitation phase of An Kim Hai Channel the anaerobic sediment layer at the bottom of channel will be disturbed. The gases generated during the process of anaerobic decomposition (CO_2, CH_4, H_2S, etc.), are now released into the air. The result of air quality measurement at the dredging locations of Nhieu Loc - Thi Nghe channel in Ho Chi Minh City shows clearly this impact. In

the areas where there was no dredging the H_2S varied between 0.01 mg/m^3 and 0.345 mg/m^3. In the areas where dredging was going on, a strong stinking odor was spread all over the area, especially when the sludge was loaded in a barge or truck, the stinking smell is directly disseminated in the air. At the sludge disposal sites, the gases existing in the sludge and the gases generated due to the further decomposition of organic matters will pollute the air.

The dredging and sludge transportation will cause air pollution due to the exhausted gases and dust from the machines and trucks. It is estimated that during the operation there will be 40 trucks, barges, bulldozers, excavators and rollers operating in the site. The degree of pollution will depend on factors such as the number of trucks, type of trucks, the fuel used, the quality of the road. The pollution load due to the transportation can be estimated based on the pollution load coefficients established by the US Environmental Protection Agency and the WHO as follows:

Pollution Load Coefficient

Pollutant	***Pollution load (kg/km)***		
	< 1,400 cc engine	< 1,400 - 2,000 cc engine	> 2,000 cc engine
	0.07	0.07	0.07
SO_2	1.9 S	2.22 S	2.74
NO_2	1.64	1.87	2.25
CO	45.6	45.6	45.6
VOC	3.86	3.86	3.86
Lead	0.13P	0.15 P	0.19 P

S is the concentration of sulfur in the lubricant (0.1 %)
P is the lead concentration in the fuel (0.04 %).
Source: US- EPA

The influence of waste gases from the equipment and means of transport on the air environment will be small, temporary and local.

2) Noise

The construction work for rehabilitation of An Kim Hai Channel and Phuong Luu Lake will last five years and will be divided into five sections. Therefore the impacts of noise will be different in each area. However, in general the noise level will be low and will occur only during short periods in each section and only during the working time.

The dredging, excavation and transportation of earth and sludge requires back hoes, bulldozers and trucks, each of them may cause a noise level from 72 to 90 dB at a distance of 15 m. The trucks will mainly drive along the main streets. The noise will not be high and will not have great impact on the environment, and the noise will be within limits of the standard.

(3) Impacts on Water Environment

Dredging, removal of solid waste, water plants and other objects from channel, embankment construction at each section and pumping water downstream will

disturb sludge, which might contains organic, inorganic material, heavy metals, and possible hazardous organic substances. This disturbance might happen in sections under rehabilitation and construction as well as at the downstream regions. These substances will disperse further increasing water pollution level in other channel sections or directly influence quality of the Cam River. On the other hand these soluble substances, especially in the form of oil, grease, emulsion and suspension, which might contain hazardous substances like Polychlorinated Biphenyl (PCB) settle and stuck on sludge dispersing further into the environment due to dredging activities. The same happens to heavy metals at outlets of industrial wastewater to drainage channel.

Construction, excavation, leveling and dredging of channel bottom might cause infiltration of wastewater into groundwater and local contamination of groundwater is possible.

An Kim Hai channel serves both as drainage channel and irrigation channel, even for domestic purposes at the end of the channel. Changes of flow will entail certain impacts on irrigation in section V. For the time being about 4-5 irrigation ditches is receiving water from An Kim Hai Channel.

According to survey results along An Kim Hai Channel over 90% of households has private toilet and most of them also septic tank. Septic tanks located in the site clearance area might be source of environmental pollution during construction.

The dredged sludge contains a large amount of water. During transportation to disposal site water may spill on the road. At the disposal site sludge might pollute surface water and entailing negative impacts on communities and relating ecosystem, if mitigation measures were not done.

(4) Impacts on Soil Environment

During the construction stages of the project, the following amount of sludge and earth will be dredged and excavated:

- The amount of debris from demolishing houses and other structures for site clearance is estimated to be 1,460 m^3
- The amount of sludge dredged from 10 km of the main channel system is about 77,231 m^3
- The amount of earth excavated during the construction of the channel and Phuong Luu lake is estimated to be about 184,065 m3 and 480,000m3 respectively

After drying at disposal site the sludge dredged from the channel can be used for ground filling or agriculture, if the quality fulfills the standard. The earth excavated during the construction of Phuong Luu lake can be used for agriculture and ground

filling. This will bring not only environmental benefits but also economic such as reduction of the transportation cost and disposal cost.

However, when using the sludge for agriculture attention should be paid to the following issues:

- Heavy metals (Pb, Cr, Hg, As, etc.) and toxic substances (PCBs, pesticides, etc.) may enter and accumulate in the plants, affecting the people consuming them in the food chain
- Due to the biological decomposition process, most of organic substances are transformed into inorganic substances (CO2, NH4+, CH4), which are swept by the water or dispersed in the air. If the sludge is mainly of inorganic substances (sand), and if it is used as fertilizer without thorough investigation, this sand in the soil will deteriorate its fertility and its capability to retain water and its rehabilitation will be many times more costly.

The leachate from the sludge might pollute the water and the soil environments. The pollutants may be easily decomposed organic substances, stable organic substances such as oil, grease, lignin, etc., toxic compounds pesticides and heavy metals (Pb, Cr, Hg, As, etc.).

The impacts of the project to soil will be insignificant.

C.2.4.4.2 Construction of Phuong Luu Lake

The biggest environmental impact is the permanent change of land use from agricultural land to pond and recreational area. However, the area is in the vicinity of Highway No. 5 and development area, and in the long-run this change is positive.

Excavation of lake will possibly break the geological structure and contamination of the upper aquifer is possible, if mitigation measures are not followed. Use of groundwater for domestic purpose during construction is not recommended. Currently many households in the area use water from 30 - 40m deep dug wells.

Transportation of excavated earth will cause temporary nuisance in the area increasing dust and noise.

C.2.4.5 Environmental Impacts during Operation Phase

Activities including to this phase are: maintenance of embankments An Kim Hai Channel and Phuong Luu Lake, and periodic dredging and cleaning of An Kim Hai Channel for the needs of drainage system. Potential environmental impacts are:

- Sludge and solid waste dredged during the maintenance process of the channel
- Solid waste collected from the screens of the discharge gates

C.2.4.5.1 Impacts on Air Environment

The impacts on air environment during the operation are insignificant.

C.2.4.5.2 Impacts on Water Environment

After the project is completed, the water quality in the project area will be considerably improved, thus generating many positive socio-economic effects as well as ecological improvement in the channel. During operation phase periodical dredging of lake and channel increase temporarily turbidity, organic substances etc. This disorder is, however, minor and temporary.

The project will also help control encroachment and illegal dumping of solid waste to the channel and discharging of wastewater to the channel , thus improving of water quality and water environment.

C.2.4.5.3 Impacts on Soil Environment.

Solid waste will be collected from grit chambers of CSOs along the channel. This amount will be large but inconsistent. Currently, due to low awareness on environmental sanitation, people dump waste into the channel and the waste amount collected from screens will be great. Little by little when the people's awareness is increasing amount of waste will be considerably reduced.

Sludge from periodic dredging from An Kim Hai Channel and Phuong Luu Lake is not much, but have to be disposed in the proper way. If sludge is containing much sand it is not good for fertilizer.

In general the impacts on soil during operation are insignificant.

C.2.4.5.4 Impacts on Human Environment

According to the set targets, the project will limit surface water pollution, and spreading of diseases as well as creating better water quality for agricultural irrigation, thus contributing to improvement of living conditions and urban environmental sanitation.

- Areas which are suffering from frequent floods will be reduced and diseases will be decreased. These positive impacts will lessen the budget burden for treatment and protection of community health.
- The implemented project will create more employment for residents, at the same time enhance the community awareness on environmental protection
- For aesthetic aspect, the project contributes the city to be more beautiful and improve urban living conditions. The project is also improving a sense of responsibility of each citizen on environmental

When the floods in urban area are reduced, floods will not directly affect business as before. This will decrease losses of thousands of million VND annually and save other hundreds of billion for reparation and maintenance of damaged equipment and infrastructures every year.

C.2.4.6 Summary of Environmental Impacts of the Drainage Project

The proposed drainage project is expected to bring the following positive impacts: (I) improvement of drainage system, (ii) reduction of flood problems, (iii) improvement of public health condition, and (iv) improvement of landscape.

The biggest adverse impacts during the project implementation are: (I) land acquisition and resettlement of about 1000 – 1300 households, (ii) transportation and disposal of dredged material, (iii) construction of embankment and maintenance roads, and (iv) general nuisance during dredging, excavation and transportation, including dust, noise and offensive odor.

Assessment of Advantages and Disadvantage of Project to Living Environment

Cause			Time Scale	Need for mitigation
	Positive	**Negative**		
Land acquisition and resettlement		- - -	Long-term	Yes
Odor during dredging and sludge disposal site		- - -	Temporary	Yes
Noise during construction		- -	Temporary	Yes
Dust during construction work		- -	Temporary	Yes
Traffic jam during construction		- -	Temporary	Yes
Relocation of structures (power lines, underground pipes etc)		-	Temporary	Yes
Risk of soil and groundwater contamination during construction and sludge disposal		-	Temporary	Yes
Safety for worker		-	Temporary	Yes
Influences on spiritual and cultural values	+	-	Temporary	No
Sludge recycle and reuse for landscaping	+		Temporary	No
Usage of sludge as fertilizer	+		Temporary	No
Employment creation	+		Temporary	No
Reduction of pollution to water supply system	+		Long-term	No
Enhancement of storage capacity of regulation lake	+ +		Long-term	No
Aesthetic improvement	+ +		Long-term	No
Reduction of water related diseases	+ +		Long-term	No
Health improvement	+ +		Long-term	No
Reduction of losses due to flood	+ +		Long-term	No
Improvement of hydraulic condition in the channel	+ + +		Long-term	No
Reduction of flood	+ + +		Long-term	No

Legend:
- - - Very negative - - Negative - Less negative
+ Less positive + + Positive + + + Very Positive

The table above shows that the positive aspects of the project exceed the negative ones. Most of the negative impacts are temporary and short time while the positive impacts are long-term.

The major environmental impacts from dredging of An Kim Hai Channel and construction of Phuong Luu Lake are shown more detailed in the Data Book.

C.2.5 Mitigation Measure

C.2.5.1 Mitigation Measures during Design Phase

C.2.5.1.1 General Design Instructions

Environmental matters have to be integrated in all the design work and planning of the project. The designing has to be done by minimizing the adverse impacts on environment using as much as possible existing facilities and selecting the location of new facilities in areas where the disturbance to environment, people and existing structures is the smallest. Where possible existing rights-of-way has to be used rather than create new ones.

According to the Vietnamese Construction Regulation Standard Article 3.3 Protection of Natural Resources and Environment construction projects should:

- Not cause adverse effect to environment, and technical regulations on scenery and environment protection should be observed
- Protect the natural preservation areas, and historical, cultural and architectural places
- Extracting natural resource must ensure the rationality and cause no obstacle to the next exploitation
- Respect traditional customs, practices, religions of people living in and around the construction area

C.2.5.1.2 Drainage Design Instructions

The channel dredging has to be designed so that the need of site clearance and resettlement is minimized. However, the width of maintenance roads (margins) on both side of channel should be at minimum 5 m to ensure effective maintenance and control illegal encroachment.

In the selection of dredging method, special attention has to be paid to constraints imposed by the wide range of channel cross-sections, the access limitations for conventional plant and machinery, the availability of suitable sites for sludge disposal, and the operational procedures required for SADCo, or other Employer, to improve the situation. The drainage channel should be dredged during the dry season.

The hydraulic capacity of the existing channel is not adequate, the channel will be widened to achieve an adequate flow transmission capacity. The channel banks will be lined with revetment and some new crossing bridges will be provided under the project as supporting component.

C.2.5.1.3 Land Acquisition and Resettlement Sites

Detailed measurement survey has to be conducted and exact number and type of houses and infrastructure to be relocated has to be identified. Land acquisition and resettlement has to be done according to the approved resettlement procedures described in Resettlement Action Plan to be prepared during the detailed design phase of the project.

The preliminary estimation for the needed resettlement area is 5 – 8 ha depending on the type of houses to be constructed. Two resettlement sites are proposed, one along Highway No. 5 and one south of Phuong Luu Lake. Third possible option is development of resettlement area around the proposed Phuong Luu Lake. Location and size of resettlement areas has to be decided during the detailed design phase, and design the necessary infrastructure and other structures.

In order to accommodate affected residents, SADCO has proposed development of residential quarter. The estimated size of the resettlement area is in total 8.6 ha, and the cost for the development of infrastructure for the resettlement area is 720,000 USD. The proposed area should be able to accommodate about 1,066 households.

Estimated Cost for Development of Resettlement Area

Category	Est. Cost (USD)
Estimated Total Cost	720,000
- Leveling	360,000
- Basic Infrastructure*	145,000
- Land Compensation	215,000

* : include sewer, electricity and other infrastructure
source: SADCo and Const. Works Design Inst., January 2000.

Public hearings should be organized during design phase to inform people the content and schedule of the project, and resettlement procedures.

C.2.5.2 Mitigation Measures during Construction Phase

C.2.5.2.1 Noise, Odor, Litter and Dust

The release of heavy metals and possible organic micro-pollutants and loose sediments to channels and from here on to the river during dredging works in the lakes has to be minimized by preventing water discharge into the channels.

Sludge disposal can be done in temporary disposal sites located on wasteland or agricultural land downstream of An Kim Hai Channel. According to the analyzing results there is no need of special treatment of sludge. To minimize odor mixing with other material is recommended. Protection strips have to be designed around sludge disposal area to separate it from the surroundings.

Maximum permitted noise level in public and residential areas is given in Vietnamese standard TCVN 5949-1995. The strongest limitations are from 10 p.m. to 6 a.m. in the vicinity of hospitals, sanatoriums, libraries and kindergartens where maximum noise level is 40 dB.

During dredging works there will be a local odor nuisance to the public as long as the dredging works will take place. To minimize the odor nuisance the dredging works have to be carried out during dry season.

It is extremely important to inform the local people in advance about the public nuisance during the dredging and other rehabilitation works.

Appropriate equipment should be used to prevent overloading of sludge tankers and to collect accidental spills (sludge, oils from equipment, etc.) during rehabilitation, construction and dredging works.

The Constructor is responsible to collect all the solid waste from dredged channel and transport it to the landfill.

In construction sites dust, litter and public inconvenience has to be minimized by good construction management and site supervision. To minimize dust emissions caused by construction works, sprinkling the streets with water is recommended in the vicinity of construction sites.

Trees and preserving a green areas along the channel and around the lake are effective measures to mitigate water, air and soil pollution, creating favorable condition for development of terrestrial plants in a balanced state.

C.2.5.2.2 Water and Sediment Quality

The dredging should be started from upstream and each section should be completed fully before starting the next ones. During dredging attention should be paid to changes of soil and water quality to identify geological windows. Appropriate measures have to be applied to minimize groundwater pollution.

During construction, oil and waste from transportation trucks and machines has to be collected and disposed in the suitable place to avoid water pollution.

Attention should be paid to dredging operation, which may contaminate the water and increase turbidity. During operation process is needed to minimize impacts on aquatic environment. Disturbance of aquatic environment downstream of the channel should be limited. The construction activities must ensure circulation of water flow.

Release of dredged material to downstream water bodies has to be minimized. The generation and dispersion of turbidity has to be minimized by using special dredging equipment.

Release of heavy metals and possible organic micro-pollutants and loose sediments to channel and from there to river during dredging works has to be minimized.

C.2.5.2.3 Health and Safety

In all construction works local health and safety working methods and instruction given in project documents have to be followed up.

(1) Safety, Security and Protection of the Environment

The Contractor shall, throughout the execution and completion of the works and remedying of any defects therein:

- Have full regard for the safety of all persons entitled to be upon the site and keep the site and the works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons.
- Provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and
- Take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

(2) Accidents and Insurance

The Employer has no responsibility for injuries that may be suffered by employees of the Contractor, unless such injury results from an act or default of the Employer. In such circumstances the injured person would be regarded as a "third party" to the Employer and the Employer would have the benefit of the Third Party insurance.

During the execution of the works the Contractor shall keep the site reasonably free from all unnecessary obstructions and shall store or dispose of any Contractor's equipment and surplus materials and clear away and remove from the site any wreckage, rubbish or temporary works no longer required.

The Contractor shall have on his staff at the Site an officer dealing only with questions regarding the safety and protection against accidents of all staff and labor. This officer shall be qualified for his work and shall have the authority to issue instructions and shall take protective measures to prevent accidents.

(3) Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labor and, in collaboration with and to the requirements of the

local health authorities, to ensure that medical staff, first aid equipment and stores, sick bay and suitable ambulance service are available at the camps, housing and on the Site at all times throughout the period of the Contract and that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygienic requirements.

The Contractor is responsible to provide appropriate equipment, tools and protective clothing to the workers. The Contractor has to ensure that appropriate working methods are applied.

Anti-vibration mountings and noise insulation on equipment has to be used when possible. The Contractor has to provide and train how to use ear protectors for workers when noise level in the working place exceeds 85 dB.

The removed material from construction sites has to be handled, transported and disposed according to the safety instructions.

(4) Safety and Health during Dredging of Channels and Sludge Disposal

The Contractor has to follow strictly safety and health regulations during dredging of channel and during transportation and disposal of dredged sludge.

The dredging has to be organized so that the need to go to water is minimized.

Special attention has to be paid to avoid the straight contact with sludge. The Contractor has to provide protective clothing including waterproof overall, safety wellingtons and gloves. Workers have to use protective measures to avoid skin or eye contact and inhalation has to be use during dusty work periods, e.g. during drying of the sludge, loading and unloading of the dried sludge and any direct contact with the sludge. Proper PVC gloves have to be used as well as mask and goggles to protect face and eyes. It is recommended that pregnant women are not working with the sediments because the possible high chromium concentrations.

A possibility to proper washing with clean water has to be arranged during and after the working.

Clean water and first aid kit has to be available to wash and treat the possible cuts and wounds.

C.2.5.2.4 Traffic and Transportation Arrangements

(1) Interference with Traffic and Adjoining Properties

All operations necessary for the execution and completion of the works and the remedying of any defects therein shall be carried on so as not to interfere unnecessarily or improperly with:

- The convenience of the public

- The access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

The contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors. In particular, the Contractor shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, plant, Contractor's equipment or temporary works from and to the site shall be limited, as far as reasonably possible.

(2) Transportation of Sludge from Sewers, Channels and Lakes

The nuisance caused by transportation of materials and especially dredged sludge has to be minimized by arranging transportation and construction on busy main streets only outside rush hours and in narrow streets in residential areas only during the day. The transportation has to be avoided between 10 p.m. to 6 a.m. and is allowed only on the request of traffic police. The noise level limitations given in the Vietnamese standard TCVN 5949-1995 have to be followed.

Careful planning of dredging, construction and transportation schedules, and planning and selection of routes, as well as choice of transportation vehicles will minimize dust.

Loads have to be covered tightly to minimize spread of dust and preventing dropping of material from the loads to the roads. Sludge with high water content has to be transported in special sludge tank to avoid any spills to the roads.

C.2.5.2.5 Working Time and Site Arrangements

(1) Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Engineer, proposed Site regulations for the Employer's approval, which approval shall not be unreasonable withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the facilities, gate control, sanitation, medical care, and fire prevention.

Sign to show the name of the Project, the name of Employer and the name of Contractor has to locate in visible place in the construction site.

(2) Site Clearance

Site Clearance in course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

Clearance of the Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site, and shall leave the Site and Facilities clean and safe.

(3) Watching and Lighting

The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

(4) Work at Night and on Holidays

Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Engineer.

C.2.5.2.6 Public Relations

The Employer (SADCo) shall announce the rehabilitation works and new traffic arrangements during rehabilitation works to the public regionally in newspapers, TV and radio. Locally the announcement is given to the phuong representatives who will inform the residents. Loudspeakers can be used during the construction work to give the latest information in concerning areas. It is extremely important to inform the local people in advance about the public nuisance.

C.2.5.4 Mitigation Measures during Operation phase

C.2.5.4.1 General

SADCo or other nominated Employer has the responsibility to carry out all operation and maintenance work, and arrange them using proper methods and avoiding noise, odor, litter, dust and traffic nuisance during the operation.

The same health and safety instructions as during the construction phase have to be followed also during operation phase when cleaning of channel and lake. Protective

clothes have to be provided to all workers. A possibility to proper washing with clean water has to be arranged during and after working.

Transportation has to be minimized by proper organization and management of the work. Working during night time has to be minimized.

C.2.5.4.2 Operation and Maintenance of Drainage System

(1) Inspection

SADCo or other nominated Employer will be responsible for operation and maintenance of facilities on contract with HPPC.

Regular inspection of the condition of drainage system has to be arranged as normal O&M routines. For efficient management of maintenance operations it is important that SADCo inspects all channels on a regular basis.

All O&M activities have to meet operational and safety standards.

(2) Channel and Lake Dredging

Inspection of dredged channel and constructed lake has to be arranged and re-dredging has to be done when needed. Dredged material has to be treated in proper way in disposal site.

Maintenance can be carried out by land based machinery from access roads along channels. This provides the most economic and efficient method.

Improved flow capacity and construction of collectors will decrease the need of dredging. Solid waste management along the channels and lakes has to be improved at the same time to stop filling of channels and lakes with garbage.

(3) Landscaping of Channel and Lake Banks

After the dredging and construction the lake and channel surroundings should be landscaped to create an attractive environment and recreation area for the public. At the same time HPPC or other relevant authority has to give regulations to prevent illegal housing in the lake and channel embankments.

(4) Education and Training

SADCo should arrange annual training courses to improve the skills of operation staff. This training should be part of the normal operation & maintenance practices and budget.

(5) Public Awareness Campaigns

Solid waste disposal into the channels and lakes should be prevented by public awareness campaigns and at the same time solid management should be strengthened.

C.2.5.5 Impacts with the Proposed Mitigation Measures

All of the proposed mitigation measures were designed to satisfy relevant environmental laws and regulations. Hence, the environmental impacts will be sufficiently minimized to the acceptable levels as long as these measures are implemented as planned. Details of the mitigation measures should be designed in the Detailed Design phase in order to reflect the details of the project design in the mitigation measures.

C.2.5.6 Summary of Mitigation Measures

Phase	Main mitigation measures	Responsible organization
Design	International and Vietnamese design criteria and standards to be used Maintenance roads designed so that need for resettlement is minimized Works designed to implemented during dry season	Design Consultant
Construction	Minimize dust, odor, litter, noise and traffic emissions by good operation management and site supervision Appropriate working methods have to be followed Sites have to be kept clean and safe during and after the work Safety and health regulations has to be strictly followed Protective clothing and operational training for workers is essential Transportation has to be minimized and routes selected to avoid public nuisance Transportation during rush hours and night has to be avoided Tight and proper equipment to transport sludge has to be used to avoid accidental spills and odor nuisances Construction sites and time has to be informed to the local people in advance	Contractor
O&M	Minimize dust, odor, litter, noise and traffic emissions by good operation management and site supervision Appropriate working methods have to be followed Sites have to be kept clean and safe during and after the work Safety and health regulations have to be strictly followed Protective clothing and operational training for workers is essential Transportation has to be minimized and routes selected to avoid public nuisance	PIO

C.2.6 Outline Resettlement Action Plan

C.2.6.1 General

According to the preliminary survey results collected by CCET in November – December 2000, it has been estimated that totally 1044 households should be resettled, and 770 houses will be relocated of which 227 are temporary houses, 444 level IV houses, 62 level III houses and 37 level II houses. Other structures to be relocated include: 5496 m^3 of subsidiary work, 2168m of wall, 1882m^2 of yard, 1091 m^3 water tank, 1602 trees, 14 high voltage electric poles, 115 low voltage power pole, and hundreds of cemeteries (there are two cemeteries in the proposed Phuong Luu lake, one with 130 solid built graves and 150 earthen graves, other with 560 solid built graves and 50 earthen graves. Two other cemeteries next to An Kim Hai channel are in Quan Nam (30 graves) and Dong Bun (40 graves).

Total number of households is 1044, and their location according to sections is as follows:

Section I	386 households (0,31 household/m)
Section II	275 households (0,09 household/m)
Section III	270 households (0,15 household/m)
Section IV	107 households (0,04 household/m)
Section V	6 households (0,004 household/m)

Total number of houses is 770, and their location and type according to sections as is follows:

Section I: 255 houses of which:

Temporary houses	74
Level IV houses	157
Level III houses	22
Level II houses	02

In this section, there is Dong Bun cemetery with 40 graves

Section II: 206 houses of which:

Temporary houses	96
Level IV houses	98
Level III houses	7
Level II houses	5

In this section, there is Quan Nam cemetery with 30 graves

Section III: 270 houses of which:

Temporary houses	40
Level IV houses	180
Level III houses	29
Level II houses	21

Section II and III has 9 high voltage power pole, 95 low voltage, one cemetery with 200-250 graves.

Section IV: 36 houses of which:

Temporary houses	17

Level IV houses	7
Level III houses	3
Level II houses	9

In this section, there is Phuong Luu lake with 5 high voltage power poles, 11 low voltage power poles, 210 earthen graves and 790 built graves.

Section V: 3 houses of which:

Level IV houses	2
Level III houses	1

Amount of structures

Temporary houses: 3203.5 m^3 of which:

Section I	1035 m^3
Section II	1182 m^3
Section III	682 m^3
Section IV	304.5 m^3
Section V	0 m^3

Level IV houses: 8330.5 m^2 of which:

Section I	3143 m^3
Section II	1951 m^3
Section III	3023 m^3
Section IV	100.5 m^3
Section V	113 m^3

Level III houses: 1365 m^3 of which:

Section I	501 m^3
Section II	155 m^3
Section III	451 m^3
Section IV	184 m^3
Section V	74 m^3

Level II houses: 769 m^3 of which:

Section I	185 m^3
Section II	83 m^3
Section III	348 m^3
Section IV	153 m^3
Section V	0 m^3

Subsidiary structures: 5496 m^3 of which:

Section I	2595 m^3
Section II	1503 m^3
Section III	605.7 m^3
Section IV	708 m^3
Section V	84.3 m^3

Yards:1882 m^3 of which:

Section I	839 m^3
Section II	373 m^3
Section III	396 m^3

Section IV	274 m^3
Section V	0 m^3

Walls: 2168 m^3 of which:

Section I	625 m^3
Section II	672 m^3
Section III	556 m^3
Section IV	299 m^3
Section V	16 m^3

Water tanks:1091 m^3 of which:

Section I	106 m^3
Section II	120 m^3
Section III	550 m^3
Section IV	299 m^3
Section V	16 m^3

Trees:1602 of which:

Section I	18 trees
Section II	187 trees
Section III	543 trees
Section IV	547 trees
Section V	307 trees

Residential land:24703 m^3 of which:

Section I	9052 m^3
Section II	5434 m^3
Section III	5001 m^3
Section IV	3656 m^3
Section V	1560 m^3

Estimated compensation cost for each component are calculated based on field survey results of CCET and the unit prices of the SADCo as follows:

Compensation Cost for Drainage Project

Items	Unit	Quantity	Unit price (USD)	Amount (USD)	Number of houses
Section I					
Temporary house	m^2	1035	20	20700	74
Grade IV house	m^2	3143	48	150864	157
Grade III house	m^2	501	73	36573	22
Grade II house	m^2	185	100	18500	2
Subsidiary structures	m^2	2595	25	64875	
Yard	m^2	839	5	4195	
Wall	m^2	625	5	3125	
Water tank	m^3	106	40	4240	
Trees	one	18	3	54	
Residential land	household	9052	28	253456	
Compensation for infrastructure	household	386	100	38600	
Removal allowance	household	386	65	25090	

Income recover allowance	household	386	65	25090	
Allowance for relocation difficulty	household	386	400	154400	
Earthen grave removal	tomb	30	60	1800	
Subtotal				**801,562**	
Section II					
Temporary house	m^2	1182	20	23640	96
Grade IV house	m^2	1951	48	93648	98
Grade III house	m^2	155	73	11315	7
Grade II house	m^2	83	100	8300	5
Auxiliary structures	m^2	1503	25	37575	
Yard	m^2	373	5	1865	
Wall	m^2	652	5	3260	
Water tank	m^3	121	40	4840	
Trees	one	187	3	561	
Residential land	household	5434	28	152152	
Compensation for infrastructure	household	275	100	27500	
Removal allowance	household	275	65	17875	
Income recover allowance	household	275	65	17875	
Allowance for relocation difficulty	household	275	400	110000	
Earthen grave removal	tomb	40	60	2400	
Subtotal				**512,806**	
Section III					
Temporary house	m^2	682	20	13640	40
Grade IV house	m^2	3023	48	145104	180
Grade III house	m^2	451	73	32923	29
Grade II house	m^2	348	100	34800	21
Auxiliary structures	m^2	606	25	15150	
Yard	m^2	396	5	1980	
Wall	m^2	556	5	2780	
Water tank	m^3	550	40	22000	
Trees	one	543	3	1629	
Residential land	household	5001	28	140028	
Compensation for infrastructure	household	270	100	27000	
Removal allowance	household	270	65	17550	
Income recover allowance	household	270	65	17550	
Allowance for relocation difficulty	household	270	400	108000	
Subtotal				**580,134**	
Section IV					
Temporary house	m^2	304.5	20	6090	17
Grade IV house	m^2	100.5	48	4824	7
Grade III house	m^2	184	73	13432	3
Grade II house	m^2	153	100	15300	9
Auxiliary structures	m^2	708	25	17700	
Yard	m^2	247	5	1235	
Wall	m^2	299	5	1495	
Water tank	m^3	299	40	11960	
Trees	one	547	3	1641	
Residential land	household	3656	28	102368	
Compensation for infrastructure	household	107	100	10700	
Removal allowance	household	107	65	6955	
Income recover allowance	household	107	65	6955	
Allowance for relocation difficulty	household	107	400	42800	
Removal of built grave.	household	690	100	69000	

Earthen grave removal	tomb	110	60	6600	
Subtotal				**319,055**	
Section V					
Grade III house	m^2	113	48	5424	2
Grade IV house	m^2	74	73	5402	1
Auxiliary structures	m^2	84	25	2100	
Wall	m^2	16	5	80	
Water tank	m^2	16	40	640	
Trees	m^3	307	3	921	
Residential land	household	1560	28	43680	
Compensation for infrastructure	household	6	100	600	
Removal allowance	household	6	65	390	
Income recover allowance	household	6	65	390	
Allowance for relocation difficulty	household	6	400	2400	
Subtotal				**62,027**	
Others					
Metal bridge	m^2	150	100	15000	
Concrete bridge	m^2	437	100	43700	
Bamboo bridge	m^2	395	50	19750	
Agricultural land.	m^2	240000	3	720000	
Subtotal				**798,450**	
Grand total				**3,074,034**	

Sources: Survey results of the SADCo.
Supplemented survey results and calculation of the CCET, 11-12/2000

These calculations were done according to the design criteria that there will be maintenance roads 5 m on the other side and 2 m on the other side of the channel. Later the design has changed and there is proposed to be at least 5 m maintenance margin on the both side of the channel. This is estimated to increase the number of households to be resettled about 20 %. According to this about 1300 households should be resettled and about 1000 houses to be relocated totally or partly. The increased compensation cost is estimated to be about 3.7 million USD.

C.2.7 Monitoring Programs

C.2.7.1 General

C.2.7.1.1 Objectives

The objective of monitoring is to collect information on the changes of environmental quality due to project implementation, thereby timely identifying adverse impacts to the environment and propose of mitigation measures for environmental pollution. On the other hand, environmental monitoring also aim to ensure the safety of project operation.

C.2.7.1.2 Content

The content for environmental monitoring programs for the project include:

- Monitoring of affected groups
- Monitoring of air environment
- Monitoring of water environment including surface water, groundwater and sediment

C.2.7.2 Monitoring of Project Affected People

In order to fully understand the benefits of the project and to enhance public awareness on environmental protection along An Kim Hai Channel monitoring is needed.

The location for monitoring will be in typical residential areas along An Kim Hai Channel, around Phuong Luu lake and in the new resettlement areas. The number of interviews is proposed to be 100, and interviews are done randomly.

The content of monitoring will, to some extend, be similar to that of socio-economic survey before project implementation. However, it should be focused on the project‘s impacts on the environmental quality, community health and employment.

Monitoring will be carried out every 6 months, the first times being 1 month after the project has started. Based on survey results, shortcomings of the project will be mitigated.

C.2.7.3 Air Quality Monitoring

Air monitoring will be carried out in the project area, its vicinities and affected residential areas. Locations of ambient air monitoring are proposed to be in the most densely populated three sections of An Kim Hai Channel. Monitoring will be done once per month. There will be six samples from each three sampling point.

Ambient Air Monitoring Indicators

No	Indicator	Air monitoring station.		
		Inside	Outside	Baseline
1	SO_2	*	*	*
2	NO_2	*	*	*
3	CO	*	*	*
4	CH_4	*		*
5	H_2S	*		*
6	Suspended dust	*	*	*
7	Pb in dust	*	*	*
8	Meteorology			
8.1	Rainfall			*
8.2	Wind			*
8.3	Temperature			*
8.4	Humidity			*
8.5	Evaporation			*
8.6	Radiation.			*

Legend: Wind monitoring: velocity and direction.
Rain monitoring : Volume per day

C.2.7.4. Water Quality Monitoring

C.2.7.4.1 Surface Water Monitoring

Monitoring points along An Kim Hai Channel are proposed to be as follows:

- Tran Nguyen Han road
- Lach Tray road
- Ha Doan gate
- Phuong Luu lake
- Phi Truong tidal gate

Monitoring Frequency and Indicator of Surface Water Analysis from An Kim Hai Channel

Groups	Indicators	Sample frequency			TCVN 5942-1995 Column B
		Once/week	Once/month	Once/quarter	
I	Physical indicator				
	Temperature		*		
	PH		*		5.5-9.0
	Total solid		*		80.0 mg/l
II	Oxygen indicators				
	DO	*			>2.0 mg/l
	BOD_5 (20)	*			<25.0 mg/l
	COD	*			<35.0 mg/l
III	Nutrients				
	Total N		*		
	Total P		*		
	PO_4-P		*		
	NH_4^+ -N		*		1.0 mg/l
	NO_3-N		*		15.0 mg/l
	NO_2- N)		*		0.05 mg/l
IV	Chemical indicators				

	Total Phenol			*	0.002 mg/l
	Oil, grease			*	0.3 mg/l
	Detergent			*	0.5 mg/l
V	Heavy metals				
	Total Fe			*	2.0 mg/l
	As			*	0.1 mg/l
	Cd			*	0.02 mg/l
	Pb			*	0.1 mg/l
	Hg			*	0.002 mg/l
	$Cr^{(VI)}$			*	0.05 mg/l
	$Cr^{(III)}$			*	1.0 mg/l
	Mn			*	0.8 mg/l
	Zn			*	2.0 mg/l
	Sn			*	2.0 mg/l
VI	Biological indicators				
	Total Coliform		*		10,000 MPN/100 ml
	Fecal. Coliform		*		

Leachate is proposed to be monitored from two disposal sites during construction period.

Monitoring Frequency and Indicators of Leachate

Group	Indicators	Sampling frequency			VN Standard 5945 - 1995
		Once/week	Once/month	Once/quarter	
I	Physical indicator				
	Temperature	*			40^0C
	PH	*			6 - 9
	Total Solid	*			50 mg/l
II	Oxygen indicators				
	BOD_5		*		20 mg/l
	COD		*		50 mg/l
III	Nutrients				
	Total N		*		
	Organic P		*	*	0.2 mg/l
	Total P		*	*	4.0 mg/l
	NH_4^+ -N		*	*	0.1 mg/l
IV	Chemical indicators				
	Cloride		*		1.0 mg/l
	Fluoride			*	1.0 mg/l
	Sulphate			*	0.2 mg/l
	Phenol			*	0.001 mg/l
	Oil			*	-
	Tetracloetylen			*	0.02 mg/l
	Tricloetylen			*	0.05 mg/l
V	Heavy metals				
	Total Fe			*	1.0 mg/l
	As			*	0.05 mg/l
	Cd			*	0.01 mg/l
	Pb			*	0.1 mg/l
	Hg			*	0.005 mg/l
	$Cr^{(VI)}$			*	0.05 mg/l
	$Cr^{(III)}$			*	0.2 mg/l
	Mn			*	0.2 mg/l
	Zn			*	1.0 mg/l

	Sn			*	0.2 mg/l
VI	Biological indicators				
	Total Coliform		*		5000 MPN/100ml

C.2.7.4.2 Groundwater Monitoring

Groundwater monitoring sampling is proposed to be in Phuong Luu Lake area and in the vicinity of sludge disposal sites.

- Well No 1: 50m to the south of Phuong Luu lake (hamlet 1)
- Well No 2: 50m to the north of Phuong Luu lake (hamlet 1).
- Well No 3 and 4 in the vicinity of sludge disposal site

Monitoring Frequency and Indicators of Groundwater

Group	Indicators	Frequency of monitoring			TCVN 5944-1995
		One/week	One/month	One/quarter	
I	Physical indicator				
	pH				6.5-8.5
	Color		*		5-50
	SS (mg/l)		*		750-1500
II	Nutrients				
	NH_4^+ -N (mg/l)				-
	NO_3-N (mg/l)				45
III	Toxic indicator				
	Phenol (mg/l)		*		0.001
IV	Heavy metal				
	As (mg/l)			*	0.05
	Cd (mg/l)			*	0.01
	Pb (mg/l)			*	0.05
	$Cr^{(VI)}$ (mg/l)				0.05
	Cu (mg/l)			*	1.0
	Zn (mg/l)			*	5.0
	Mn (mg/l)			*	0.1-0.5
	Mercury (Hg) (mg/l)			*	0.001
	Total metal			*	-
V	Biological indicator				
	Total Coliform (MPN/100ml)		*		3
	Fecal Coliform (MPN/100ml)		*		-

C.2.7.5 Other Monitoring

Periodical monitoring and examination of the drainage system should be included to the normal operation & maintenance routines. The monitoring frequency is once a month.

- Land subsidence, slide, damage of embankments, sewers network, bridge across the channel, maintenance road
- Waste disposal to the channel banks
- Grit chambers of CSOs

- Flood related to the channel operation
- Operation of drainage channel, retention lakes and tidal gate

C.2.7.6 Monitoring Cost

Type of Monitoring	VND / year	USD /year
Monitoring of Project Affected People		
Cost for questionnaire collection 20 days x 5 questionnaires/day x 150,000 VND = 15,000,000 VND *Cost for collection of information* 100 questionnaires x 15,000 VND = 1,500,000 VND *Cost for periodical health checking* 2 times/year x 15,000,000 VND = 30,000,000 VND		
Sub-total	46,500,000	3,304
Air Quality Monitoring		
Cost for sample collection 3locations x 12 times x 1,000,000 VND = 36,000,000 VND *Cost for sample analysis* 3 locations x 18 samples x 7 indicators x 30,000 VND = 11,340,000 VND		
Sub-total	47,340,000	3,364
Water Quality Monitoring		
Cost for sample taking *Groundwater:* 4 wells x 4 samples/year x 200,000 VND = 3,200,000 VND *Surface water*: 7 points x 12 sample/year x 100,000 VND =8,400,000 VND *Cost for sample analysis* 11 points x 16 samples/year x 720,000 VND = 126,720,000 VND		
Sub-total	138,320,000	9,829
Grand total	**232,160,000**	**16,497**
Other Monitoring		
2 people/time x 12 times/year x 150,000 VND/person/day = 3,600,000 VND	3,600,000	226

The total cost for environmental monitoring in a year will be 232,160,000 VND equivalent to 16,497 USD.

C.3 Environmental Impact Assessment for Sewerage Project

C.3.1 Project Description

C.3.1.1 Project Area and Components of the Project

The salient features of the sewerage priority project are as follows:

- Location: Central area of Class A Area
- Area: 1,104 ha
- Population: 239,000 in 2010
- Collection system: Combined sewer system
- Estimated sewage: 36,000 m3/day in 2010
- Treatment plant: Near Vinh Niem tidal gate
- Implementation period: 2004 to 2010

C.3.1.2 Planning Concept and Design Criteria

C.3.1.2.1 Sewage Disposal System

Population density is the key parameter in determining appropriate level of sewage disposal system for a given area. The following population density-based selection criterion was adopted to select appropriate sewage disposal system in the Study Area.

Population density	Range	Target
High	More than 40 person/ha	Sewer system
Medium	11-39 person/ha	Septic tank based system
Low	Less than 10 person/ha	Improved latrine

The sewerage priority project proposes to intercept the combined flow before it enters into the surface water bodies and separate sewage from storm water by the means of Combined Sewer Overflows (CSO). Sewage is to be collected by lateral, trunk and conveyance sewers to the wastewater treatment plant (WWTP). Conveyance is proposed to be placed along the National Road No.5 This will collect wastewater from trunks and transport the wastewater to the WWTP near the Vinh Niem tidal gate. Sewage lift pumps is to be placed in case of gravity flow becomes difficult. Sewage is to be treated in WWTP satisfying VN standard before discharging into river. Storm water separated in CSOs is to be allowed to bypass into surface water bodies.

C.3.1.2.2 Wastewater Treatment Plant

Proposed location of for the WWTP in the Master Plan of the Study was identical to that proposed by Haiphong Sanitation Master Plan. In the Master Plan Modified Stabilization Pond (MSP) and Aerated Lagoon (AL) were proposed. Though MSP is less expensive method, it requires larger land and its effluent quality can not

satisfy Vietnamese standard. After detail discussion with PMU, TUPWS, SADCO and UPI, it was decided to adopt aerated lagoon as the treatment process.

According to Vietnamese regulation, a buffer zone is required around the WWTP, the values depend on the plant size. For the present case, it is 25 m from dike, 10 m from provincial road and 5 m from waterways.

Considering all alternatives, the Study proposes to relocate the dike and shift one road slightly in order to ensure sufficient area for WWTP and its buffer area. The present dike is far from the river edge and vast area is not utilized for any purpose. By relocating the dike, this unutilized land can be effectively used for the WWTP. Shifting of the dike would be between 50 to 100 m. The Study also proposes to shift the north-south oriented road for about 60 m towards west to make it possible to construct the WWTP.

C.3.1.2.3 Pumping Station

Three potential locations were selected for the proposed main pumping station site; Van Cao, Kieu Son and An Da. Detailed investigations for these sites including topographic survey, geotechnical investigations and environmental impact assessment were carried out. According to the design calculations one pumping station is required to collect wastewater from the service area.

An Da site was selected from the following consideration:

- No resettlement is required
- Cost-effective from technical aspect
- Far from national road No. 5
- Ease of construction as located by the side of planned road
- Less earth filling compared to other two sites
- Low expected social and environmental impacts

C.3.2 Baseline Data Survey Results

C.3.2.1 Atmospheric Environment

C.3.2.1.1 Ambient Air Quality

In order to evaluate the ambient air quality in the project area CCET determined the ambient air quality as follows:

- Gas compounds in the ambient air SO_2, NO_2, CO and H_2S
- Suspended dust
- Heavy metals in the ambient air, lead in the suspended dust
- Meteorological indicators as humidity, temperature, wind direction, wind velocity

The measurement, analysis and evaluation of air quality samples has been carried out according to the Vietnamese standard TCVN - 1995, and if Vietnamese standards were not available the US standard (Public Health Association) has been used.

Limits of Basic Parameters of Ambient Air

No.	Parameters	Unit	1 h average	8 h average	24h average	TCVN 1995
1	CO	mg/m^3	40	10	5	TCVN 5937-1995
2	NO_2	mg/m^3	0.4	-	0.1	TCVN 5937-1995
3	SO_2	mg/m^3	0.5	-	0.3	TCVN 5937-1995
4	H_2S	mg/m^3	0.008	-	0.008	TCVN 5938-1995
5	Suspended dust	mg/m^3	0.3	-	0.2	TCVN 5937-1995

Sampling locations are as follows (Figure C.3.2.1):

- KHP 01: Vinh Niem tidal gate
- KHP 02: Mr. Oanh's house, village 3, Vinh Niem commune (from this point 10 gas samples were collected according to the requirements of JICA)
- KHP 03: Population area of village 2, Vinh Niem commune
- KHP 04: In the middle of the rice field of village 3, Vinh Niem commune
- KHP 05: The dike of Lach Tray river (in the project area)

Results of the survey point KHP1 are based on the EIA report of the Vietnam Sanitation Project - Hai Phong component, March 2000, and results of other points have been measured by CCET in November 2000:

Microclimate quality survey was carried out at point 2 in 7 continuous days. The detailed results are shown on the Table C.3.2.1. Air temperature varied from 17.2^0C to 26^0C. Dominant wind direction in this period was NE. The wind velocity varied from 0.172m/s to 1.88m/s. Humidity varied from 31% to 79%. In the area there was a slight odor, some time no odor at all.

Average Measured Concentration of NO_2, CO, H_2S, NH_3 and Dust (mg/m3) in November 2000

Points	NO_2	CO	NH_3	H_2S	Dust
KHP 1	0.00303	1.1025	-	0.0044	0.10575
KHP 2a	0.012	0.68	0.1	0.006	0.02
KHP 2b	0.016	0.46	0.1	0.004	
KHP 2c	0.016	0.37	0.4	0.001	
KHP 2d	0.024	0.46	0.3	0.001	0.04
KHP 2e	0.036	0.61	0.12	0.001	
KHP 2f	0.028	0.46	0.12	0.004	0.02
KHP 2g	0.027	0.33	0.12	0.003	
KHP 2h	0.016	0.41	0.06	0.003	
KHP 2i	0.016	0.49	0.08	0.003	
KHP 2k	0.07	0.62	0.04	0.003	
KHP 3	0.1	0.62	0.02	0.005	
KHP 4	0.044	0.61	0.02	0.008	
KHP 5	0.08	0.62	0.02	0.026	
TCVN 5937-5938 1995	0.4	40	0.2	0.008	0.3

Source: Measuring results, CCET,11/2000

The following conclusion can be drawn from the results:

- NO_2 concentration varied from 0.012 mg/m^3 to 0.1mg/m^3. The permissible concentration is 0.4 mg/m^3. Concentrations were relatively stable, and the highest concentration was at the gate to the Lach Tray river.
- CO concentration varied from 0.33 mg/m^3 to 1.1mg/m^3. The permissible CO concentration is 40mg/m^3. CO concentrations were stable, and the highest CO concentration was at the tidal gate.
- H_2S concentration varied from 0.001mg/m^3 to 0.026mg/m^3. The permissible concentration is 0.00081mg/m^3, thus the concentrations of all places exceeded the permissible level, in some places by up to 32 times.
- NH_3 concentration varied from 0.02mg/m^3 to 0.4mg/m^3. The permissible concentration is 0.2 mg/m^3, thus two samples exceeded the permissible limit.
- The daily average values of suspended dust varied between 0.02 mg/m^3 and 0.105 mg/m^3. The permissible concentration is 0.2mg/m^3. In all points dust concentration were within the permissible limits.

C.3.2.1.2 Noise

The noise sampling and analyzing techniques were according to TCVN 5965-1995. The noise monitoring was done near Vinh Niem tidal gate (see Figure 2.1.1) in four groups. The measuring interval was 6 h and the measuring duration was 10 minutes. The assessment was done according to the Vietnamese Environmental standard, see table below.

Maximum Permissible Noise Limits (dB) in Public and Residential Areas (TCVN5949-1995)

N	Areas	Time		
		From 6 - 18h	From 18 - 22h	From 22 – 6 h
1	Areas requiring special calm: Hospitals, libraries, sanatorium, kindergartens, schools	50	45	40
2	Population areas: hotels, residential houses, administrative offices	60	55	45
3	Commercial and service areas	70	70	50
4	Production areas intervening between population areas	75	70	50

Group 1		Group 2		Group 3		Group 4	
Max (dB)	Mean (dB)	Max (dB)	Mean (dB)	Max (dB)	Mean (dB)	Max (dB)	Mean (dB)
53.9	47.9	62.8	58.8	59.4	55.1	59.2	54.9

The noise measurement results show that the noise level in the area varied from 47.9dB to 62.8dB, which is within the permissible limits for commercial and service areas.

C.3.2.2 Terrestrial Environment

C.3.2.2.1 Topography

(1) Vinh Niem Wastewater Treatment Plant

The proposed WWTP is located in the plain area, having a relatively flat terrain. The elevation is in average +1.2 to +4.5 m, the highest point is dike next to the Lach Tray River and the lowest points are the fish ponds along the dike. The average elevation of the project area is + 2.3 m.

The ponds in the project area were formed due to the excavation of the soil for building the dike. The total area of the ponds is 2.5 ha. In the project area, there are 300 m of sewer channels and 1,300 m of irrigation channels.

The detailed topography of the site of the wastewater treatment plant is presented in the results of topographic surveys done by Hai Phong Construction and Design Company – HCDC for the Study.

(2) An Da Pumping station

At the proposed construction site of the pumping station, there is a small morning glory vegetable field with flat topography. In the South there is a 500 m^2 fish pond with average depth of +1.8 to +1.9 m. In the West there is a channel from An Bien lake. In the East and North there are residential areas and vegetable field with flat terrain.

C.3.2.2.2 Geotechnical Conditions

In order to assess the Geotechnical characteristics of the site, and in order to assess the potential environmental impacts of the project to the aquifer, a geological survey was carried out by University of Mining and Geology in November 2000. Based on the above results, the geological setting of the area proposed for Vinh Niem Sewerage treatment plant is described as:

- *Layer 1*: The top backfill layer of grey, greyish brown clay in loose condition, consisting of organic decomposition. The depth varies 0.5-1.1m, averaging 0.7m.
- *Layer 2*: High plastic clay in liquid condition, found in the depth of 1-5m. This layer is 1.7-6.3m thick, averaging 3.85m, consisting mainly of grey or greyish brown clay with organic composition. The permeability coefficient varied from 3.4×10^{-6}cm/s to 5.4×10^{-6}cm/s.
- *Layer 3*: Low plastic clay of grey or greyish black in liquid condition, found in the depth of 5-10m. This layer is 2.1-11m thick. The permeability coefficient varied from 1.4×10^{-6}cm/s to 4.9×10^{-6}cm/s. This layer consists of organic decomposition.
- *Layer 4*: High plastic clay of grey or greyish black in liquid condition, consisting of organic decomposition, This layer is 2-4.5m thick, found in the depth of 10-14m.
- *Layer 5*: Low plastic clay in the depth of 14-17m. This layer is 2-2.7m thick, consisting of yellow, greyish while to multicolor clay which consisted of brown iron oxide deposit. The permeability coefficient varied from 1.4×10^{-6}cm/s to 4.9×10^{-6}cm/s.
- *Layer 6*: Low plastic clay of greyish green, greyish white, in plastic-liquid to plastic condition with thin fine sand interlayer at places and clay deposit. This layer is 14-14.5m thick, found in the depth of 17-30m.

The geological setting of the area intended for construction of Vinh Niem sewerage treatment plan consisted mainly of interpolated layers of low to high plastic clay. The hydraulic conductivities of the clay layers are in the order of 10^{-6} cm/s. Hence, the percolation of wastewater to groundwater will be limited.

C.3.2.3 Aquatic Environment

C.3.2.3.1 Hydrography and Tide Regime

Effluent from the proposed Vinh Niem WWTP will be discharged to Lach Tray River. The Lach Tray river originates from the Rang river, flows then through Kien An and discharges into the sea at Lach Tray outlet. According to the report on Investigation of rural domestic water environment in Hai Phong done by University of Mining and Geology in 1997 the total length of the river is 43.4 km and the meandering ratio is 1.44. The width is 100 - 200 m and the depth is 4 - 7 m. At Kien An measured flow rate was Qmax = 252 m^3/s, and water level was H = 2.53m on

average. The sediment content in dry season was 0.25 - 0.11 kg/m^3 and in rainy season 0.25 - 1.52 kg/m^3. The salinity was 2.85 ‰. The hydrographic regime of the Lach Tray river has fluvial character during the dry season and low tide, and marine character during the dry season and high tides.

Except the Lach Tray River, the hydrographic network in the Vinh Niem area is very sparse. There are only 300 m of drainage canal and 1,300 m of irrigation canals. These canals are both small in width and shallow in depth, with low flow rate, depending on the tide regime and the irrigation pumping rate. Adjacent to the project area there are also many small fish ponds with area of about 2.5 ha each.

To investigate the impacts of the tide on the drainage flow rate and flow velocity of the Lach Tray River measurements were carried out during different tidal periods. The results of the measurements are presented in table below:

Results of Flow Rate Measurement in Lach Tray River and Tide Levels at Hon Dau Station 11/2000,

No	Time of measurement	Date of measurement	Q(m^3/s)	Tide level (m)	Remarks
1	7h 53'	17 November 2000	-355	3.6	Rising tide
2	13h22'	17 November 2000	382	2.4	Falling tide
3	20h19'	17 November 2000	163	0.5	Falling tide
4	2h 37'	18 November 2000	-216	1.9	Rising tide
5	10h34'	20 November 2000	-161	3.2	Rising tide
6	16h41'	20 November 2000	281	2.1	Falling tide
7	22h38'	20 November 2000	132	1.1	Falling tide
8	3h59'	22 November 2000	-36	1.7	Rising tide
9	11h49'	23 November 2000	-14	2.1	Rising tide
10	15h05'	23 November 2000	120	2.0	Falling tide
11	17h55'	23 November 2000	162	1.9	Falling tide
12	22h02'	23 November 2000	-11	2.1	Rising tide

Source: Measurement result, CCET

C.3.2.3.2 Surface Water Quality

(1) Sampling Points and Evaluation Method

Lach Tray River water samples were taken from four points during different tide regimes, totally 16 samples. Two samples were taken from the fishponds (Figure C.3.2.2).

- VN01: Lach Tray river at the abutment of the Niem bridge
- VN02: Lach Tray river, at the drainage gate of the project area
- VN03: Lach Tray river at Rao bridge
- VN04: Lach Tray in Hai Ninh commune
- VN05: Fish pond in the project area

Time of sampling:

- First time: 10:00 to 12:00, 20 November 2000.

- Second time: 16:00 to 18:00, 20 November 2000.
- Third time: 21:00 to 23:00, 20 November 2000.
- Forth time: 4:00 to 6:00, 21 November 2000.

For evaluation of the river water has been used the Vietnamese Standard TCVN 5942-1995 and for groundwater TCVN 5944-1995.

(2) Water Quality of Lach Tray River

The quality of the water in Lach Tray River is influenced by the tide regime. To evaluate correctly the river water quality, water samples were collected at various times of tide fluctuation such as at the high tide, medium tide and low tide. The concentrations varied as follows:

- pH value varied from 7.3 to 7.8 being within the permissible level, and changing only little in spite of the tide.
- Dissolved oxygen varied between 5.06 mg/l and 7.66mg/l.
- BOD_5 varied from 6 to 8.2mg/l. All analyzed samples were within the permissible limits to be used for irrigation
- COD varied from 15.4 mg/l to 21.6mg/l. All analyzed samples were within the permissible limits to be used for irrigation
- Suspended solids (SS) varied from 5 mg/l to 173mg/l. One sample was within the permissible limit for domestic water supply, 3 for irrigation, 8 samples have SS concentration exceeding limit in TCVN 5942 – 1995 Column B
- Total nitrogen varied from 1.1 to 2.7mg/l. All samples were within the permissible limits of TCVN 5942-1995, column A. Ammonia concentration was always below 0.01mg/l and within the permissible limit of TCVN 5942-1995.
- Heavy metal concentrations, As, Cd, Cu, Pb, Zn, Cr, Mn, were within the permissible limits of TCVN 5942-1995 Column B
- Total Coliform number varied from 136 MPN/100ml to 1500 MPN/100ml. All samples were within the permissible limits of TCVN 5942-1995
- Oil concentration varied from 0.16 mg/l to 0.25mg/l. All samples exceeded A limits and but were below B limits of TCVN 5942-1995
- Chloride varied from 176mg/l to 1054mg/l. The water of Lach Tray River is affected by tide and seawater, therefore salinity varied according to the tide.

In general in the surface water there were no sign of pollution and all concentrations were within the permissible limits in TCVN 5942 - 1995 for irrigation and aquaculture.

Water Quality of the Lach Tray River at Niem Bridge (VN01) 20- 21 November 2000

No	Parameters	Unit	At 10:00 20 Nov	At 16:00 20 Nov	At 20:00 20 Nov	At 4:00 21 Nov	TCVN 5942-1995 (B)
1	Temperature	^{0}C	18.5	20.5	18	15	
2	Dissolved O_2	mg/l	5.12	5.06	7.44	6.36	7.2
3	PH		7.65	7.6	7.75	7.7	5.5-9
4	El. Conductivity	µs/cm	1823	966	555	1359	-
5	Turbidity	NTU	206.6	316.3	295	327.5	-
6	Salinity	$^0/_{00}$	0.820	0.176	0.263	0.557	-
7	Odor		Odorless	Odorless	Odorless	Odorless	-
8	BOD_5	mg/l	8.2	6.8	6.4	7.8	<25
9	COD	mg/l	21.6	18.4	15.4	18.4	<35
10	SS	mg/l	29.0	68.0	159	173.0	80
11	Total Nitrogen	mg/l	1.95	2.7	1.4	1.4	-
12	NH_4^+ - N	mg/l	<0.01	1.4	<0.01	<0.01	1
13	NO_2	mg/l	0.363	0.036	<0.01	0.045	0.05
13	NO_3	mg/l	0.177	0.133	0.221	0.15	15
15	Total P	mg/l	0.35	0.23	0.23	0.38	-
16	SO_4^{2-}	mg/l	49.61	74.21	61.09	28.29	-
17	Coliform	MPN/100ml	600	136	360	1000	10,000
18	Fecal Coliform	MPN/100ml	280	60	128	460	-
19	Cd	mg/l	0.0004	0.0005	0.0004	0.0005	0.02
20	CN	mg/l	0.001	0.006	0.005	0.006	0.05
21	Pb	mg/l	0.0063	0.002	0.0024	0.0041	0.1
22	Zn	mg/l	0.0048	0.0081	0.0034	0.0066	2
23	Cu	mg/l	0.0043	0.0032	0.0038	0.004	1
24	Cr	mg/l	0.0093	0.0098	0.0092	0.0088	-
25	Cr^{6+}	mg/l	0.0024	0.0025	0.003	0.0023	0.05
26	As	mg/l	0.007	0.003	0.006	0.012	0.1
27	Hg	mg/l	<0.0001	0.0006	<0.0001	<0.0001	0.002
28	Fe	mg/l	14.5	2.85	10.75	9.0	2
29	Oil	mg/l	0.24	0.18	0.22	0.22	0.3

Source: Measuring results, CCET

Water Quality of the Lach Tray River near the Drainage Gate of the Project Area (VN02) on 20- 21 November 2000

N^o	Parameters	Unit	At 10:30 20 Nov.	At 16:30 20 Nov.	At 20:30 20 Nov.	At 4:30 21 Nov.	TCVN 5942-1995 (B)
1	Temperature	^{0}C	18.5	20	18	15.5	-
2	Dissolved O_2	mg/l	6.39	6.12	7.37	7.01	7.2
3	pH		7.70	7.7	7.7	7.65	5.5-9
4	El. conductivity	µs/cm	2180	2060	555	2100	-
5	Turbidity	NTU	394	376.5	423	350.3	-
6	Salinity	$^0/_{00}$	0.875	0.878	0.243	0.878	-
7	Odor		Odorless	Odorless	Odorless	Odorless	-
8	BOD_5	mg/l	7.2	7.2	6.4	7.2	<25
9	COD	mg/l	19.6	19.6	16.8	17.2	<35
10	SS	mg/l	79.0	131.0	92	140	80
11	Total Nitrogen	mg/l	1.5	1.2	1.4	1,4	-
12	NH_4^+ - N	mg/l	<0.01	<0.01	<0.01	<0.01	1
13	NO_2	mg/l	0.198	0.105	<0.01	0.051	0.05
14	NO_3	mg/l	0.285	0.127	0.235	0.191	15
15	Total P	mg/l	0.28	0.38	0.28	0.36	-
16	SO_4^{2-}	mg/l	89.38	86.1	38.95	80.36	-
17	Coliform	MPN/100ml	250	1000	220	420	10,000

18	Fecal Coliform	MPN/100ml	120	400	100	202	-
19	Cd	mg/l	0.0002	0.0005	0.0004	0.0003	0.02
20	CN	mg/l	0.001	0.005	0.007	0.003	0.05
21	Pb	mg/l	0.0008	0.0022	0.0048	0.007	0.1
22	Zn	mg/l	0.001	0.0021	0.002	0.002	2
23	Cu	mg/l	0.0013	0.0039	0.0041	0.0037	1
24	Cr	mg/l	0.0077	0.008	0.0081	0.0096	-
25	Cr^{6+}	mg/l	0.0022	0.0026	0.0028	0.0028	0.05
26	As	mg/l	0.008	0.009	0.004	0.014	0.1
27	Hg	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	0.002
28	Fe	mg/l	5.0	6.6	5.8	6.1	2
29	Oil	mg/l	0.16	0.16	0.19	0.25	0.3

Source: Measuring results, CCET

Water Quality of the Lach Tray River at Rao Bridge (VN03) on 20- 21 November 2000

N°	Parameters	Unit	At 11.00, 20 Nov.	At 17.00 20 Nov.	At 21.00 20 Nov.	At 5.00 21 Nov.	TCVN 5942-1995 (B)
1	Temperature	^{0}C	18.7	20	17.5	15.5	-
2	Dissolved O_2	mg/l	7.62	6.79	7.66	6.96	7.2
3	pH		7.5	7.8	7.75	7.7	5.5-9
4	El. conductivity	µs/cm	7190	2010	657	2250	-
5	Turbidity	NTU	512.7	668	351	645	-
6	Salinity	$^0/_{00}$	0.348	0.82	0.263	0.456	-
7	Odor		Odorless	Odorless	Odorless	Odorless	-
8	BOD_5	mg/l	6.6	6.6	6.0	7.2	<25
9	COD	mg/l	17.4	17.4	16.8	18.4	<35
10	SS	mg/l	164	154	115	166.0	80
11	Total Nitrogen	mg/l	1.95	1.1	1.25	1.95	-
12	NH_4^+ - N	mg/l	<0.01	<0.01	<0.01	<0.01	1
13	NO_2	mg/l	0.201	0.015	0.015	0.276	0.05
14	NO_3	mg/l	0.127	0.34	0.34	0.299	15
15	Total P	mg/l	0.21	0.19	0.19	0.23	-
16	SO_4^{2-}	mg/l	290	26.65	26.65	77.08	-
17	Coliform	MPN/ 100ml	350	200	200	180	10,000
18	Fecal Coliform	MPN/ 100ml	190	96	96	68	-
19	Cd	mg/l	0.0003	0.0003	0.0003	0.0004	0.02
20	CN	mg/l	0.003	0.005	0.005	0.007	0.05
21	Pb	mg/l	0.0068	0.0036	0.0024	0.0059	0.1
22	Zn	mg/l	0.0056	0.0012	0.0031	0.0033	2
23	Cu	mg/l	0.0039	0.0031	0.0065	0.0044	1
24	Cr	mg/l	0.008	0.0015	0.009	0.0086	-
25	Cr^{6+}	mg/l	0.0019	0.0016	0.0018	0.0016	0.05
26	As	mg/l	0.01	0.009	0.011	0.012	0.1
27	Hg	mg/l	0.0005	0.0004	0.0002	<0.0001	0.002
28	Fe	mg/l	3.2	8.25	0.7	8.0	2
29	Oil	mg/l	0.18	0.18	0.17	0.15	0.3

Source: Measuring results, CCET

Water Quality of the Lach Tray River at Hai Ninh (VN04) on 20- 21 November 2000

N°	Parameters	Unit	At 11:30 20 Nov.	At 17:30 20 Nov.	At 21:30 20 Nov.	At 5:30 21 Nov.	TCVN 5942-1995 (B)
1	Temperature	^{0}C	18.4	19.5	18	16	-
2	Dissolved O_2	mg/l	7.62	7.34	7.51	7.08	7.2
3	pH	mg/l	7.3	7.75	7.85	7.65	5.5-9
4	El. conductivity	µs/ cm	12580	2320	901	2410	-

5	Turbidity	NTU	355.7	584.6	457.5	546.3	-
6	Salinity	$^0/_{00}$	1.15	0.878	0.58	1.054	-
7	Odor		Odorless	Odorless	Odorless	Odorless	-
8	BOD_5	mg/l	6.8	6.8	6.8	6.4	<25
9	COD	mg/l	19.2	19.2	19.6	18.7	<35
10	SS	mg/l	5.0	139	151	126.0	80
11	Total Nitrogen	mg/l	1.3	1.1	1.4	2.0	-
12	NH_4^+ - N	mg/l	<0.01	<0.01	<0.01	<0.01	1
13	NO_2	mg/l	0.84	0.18	<0.01	0.25	0.05
14	NO_3	mg/l	0.048	0.078	0.221	0.191	15
15	Total P	mg/l	0.45	0.35	0.23	0.26	-
16	SO_4^{2-}	mg/l	79.13	41	607.62	94.4	-
17	Coliform	MPN/100ml	450	300	340	1500	10,000
18	Fecal Coliform	MPN/100ml	220	182	182	682	-
19	Cd	mg/l	0.0005	0.0006	0.0006	0.0001	0.02
20	CN	mg/l	0.003	0.005	0.004	0.006	0.05
21	Pb	mg/l	0.001	0.0033	0.0045	0.0032	0.1
22	Zn	mg/l	0.004	0.0033	0.0016	0.0017	2
23	Cu	mg/l	0.0021	0.0037	0.0033	0.0046	1
24	Cr	mg/l	0.0094	0.0098	0.0094	0.0092	-
25	Cr^{6+}	mg/l	0.0024	0.0025	0.0019	0.021	0.05
26	As	mg/l	0.01	0.01	0.012	0.01	0.1
27	Hg	mg/l	<0.0001	0.0003	0.0002	0.0001	0.002
28	Fe	mg/l	12.25	7.0	8.0	8.25	2
29	Oil	mg/l	0.19	0.23	0.25	0.22	0.3

Source: Measuring results, CCET

Quality of pond water in Vinh Niem:

- pH value varied from 7.54 to 7.6 being within the permissible limits,
- Dissolved O_2 varied from 6.07 mg/l to 7.16mg/l and was below the limit of TCVN 5942-1995, Column B
- BOD_5 varied from 8.2 mg/l to 10.1mg/l. All samples were within the permissible limits for irrigation,
- COD varied from 20.8 mg/l to 26mg/l. All samples were within the permissible limits for irrigation
- Suspended solid (SS) varied from 11 mg/l to 16.2mg/l. All samples were within the permissible limits for irrigation.
- NO_3 varied from 0.198mg/l to 0.214mg/l. All samples were within the permissible limits of TCVN 5942-1995, column A
- Heavy metal concentrations, As, Cd, Cu, Pb, Zn, Cr, Mn, were within the permissible limit of TCVN 5942-1995
- Total Coliform number varied from 350 MPN/100ml to 400 MPN/100ml. All samples were within the permissible limit of TCVN 5942-1995
- Oil concentration varied from 0.16 mg/l to 0.17mg/l. All sample exceeded the A limit and but were below the B limit in TCVN 5942-1995

Water Quality in Fish Pond in Village 3, Vinh Niem Commune (VN05) on 20 November 2000

N^o	Parameters	Unit	At 10:30, 20 Nov.	At 16:30, 20 Nov.	TCVN 5942-1995 (B)
1	Temperature	^{0}C	19.4	20.5	-
2	Dissolved O_2	mg/l	6.07	7.16	7.2
3	pH		7.54	7.6	5.5-9

4	El. conductivity	µs/cm	4280	4290	-
5	Turbidity	NTU	79.4	77.8	-
6	Salinity	$^0/_{00}$	1.230	1.816	-
7	Odor		Odorless	Odorless	Odorless
8	BOD_5	mg/l	10.1	8.2	<25
9	COD	mg/l	26.0	20.8	<35
10	SS	mg/l	11.0	16.2	80
11	Total Nitrogen	mg/l	1.4	1.6	-
12	NH_4^+ - N	mg/l	<0.01	<0.01	1
13	NO_2	mg/l	0.0171	0.018	0.05
14	NO_3	mg/l	0.198	0.214	15
15	Total P	mg/l	0.13	0.11	-
16	SO_4^{2-}	mg/l	172.2	93.07	-
17	Coliform	MPN/100ml	350	400	10,000
18	Fecal Coliform	MPN/100ml	182	202	-
19	Cd	mg/l	0.0001	0.0001	0.02
20	CN	mg/l	0.001	0.001	0.05
21	Pb	mg/l	0.0045	0.0025	0.1
22	Zn	mg/l	0.0059	0.001	2
23	Cu	mg/l	0.0024	0.0015	1
24	Cr	mg/l	0.0078	0.006	-
25	Cr^{6+}	mg/l	0.0018	0.0015	0.05
26	As	mg/l	0.004	0.004	0.1
27	Hg	mg/l	0.0004	<0.0001	0.002
28	Fe	mg/l	1.18	0.74	2
29	Oil	mg/l	0.17	0.16	0.3

Source: Measuring results, CCET

Water Quality of SW Channel, Village 5, Vinh Niem Commune, 26/11/2000

N	Parameters	Unit	**VN17**
1	Ca	mg/l	45.05
2	Mg	mg/l	27.6
3	Fe	mg/l	0.58
4	NH_4^+	mg/l	2
5	NO_2^-	mg/l	0.13
6	NO_3^-	mg/l	1.09
7	Cl^-	mg/l	319.5
8	Hg	mg/l	<0.0001
9	As	mg/l	0.0087
10	Pb	mg/l	0.0031
11	Mn	mg/l	0.22
12	Phenol	mg/l	0.0076
13	BOD_5	mg/l	36.8
14	COD	mg/l	61.6
15	Total Organic matter	mg/l	62.2

Source: Measuring results, CCET

C.3.2.3.3 Groundwater Quality

Five groundwater samples were taken (Figure C.2.3.1):

- VN06: Mr. Hoi's drilled well, Village 3in Vinh Niem commune. The well is 40 m deep, the water level is 10 m below the surface
- VN07: Mr. Dong's drilled well, Village 3 in Vinh Niem commune. The well is 48m deep, the water level is 4m below the surface

- VN08: Mr. Oanh's drilled well, Village 3 in Vinh Niem commune. The well is 7 m deep, the water level is 16m below the surface
- VN09: Mr. Vien's dug well, Village 3 in Vinh Niem commune. The well is 7m deep, the water level is 1m below the surface
- VN10: In a drilled well, Village 2 in Vinh Niem commune. The well is 60m, the water level is 10m below the surface

Groundwater quality:

- pH value varied from 7.5 to 7.9 being within the permissible limits
- Dissolved oxygen varied from 1.25 to 4.59mg/l
- BOD_5 varied from 12.6 to 24.4mg/l
- COD varied from 27.2 to 40mg/l
- SS varied from 6 to 71mg/l
- Total P content varies from 0.41 to 0.64mg/l
- Total N varied from 3.8 to 5.5mg/l
- Heavy metal concentrations, As, Cd, Cu, Pb, Zn, Cr, Mn, were within the permissible limits of TCVN 5944-1995
- Total Coliform number varied from 12 to 320 MPN/100 ml, Fecal coliform varied from 0 to 122 MPN/100 ml. All samples exceeded the permissible limit of total coliform and 4/5 of samples exceeded Fecal coliform permissible limit of TCVN 5944-1995
- Oil concentration varied from 0.14 to 0.2mg/l
- Salinity varied from 0.878 o/oo to 1.757 o/oo, exceeding the permissible limit of TCVN 5944 -1995 from 1,5 to 2,5 times

The groundwater in the area has no indication of pollution by heavy metals. 4 of 5 groundwater samples exceeded Coliform and Fecal Coli permissible limit, and all 5 samples exceeded the permissible limit of chloride.

Groundwater Quality in Vinh Niem, 26/11/2000

No	Parameters	Units	VN06	VN07	VN08	VN09	VN10	TCVN 5944-1995 Column (B)
1	Temperature	^{0}C	18.3	17	17.4	17.2	18.5	-
2	Dissolved O_2	mg/l	4.59	2.88	1.25	2.4	1.77	7.2
3	pH		7.5	7.55	7.7	7.9	7.55	5.5-9
4	El. Conductivity	µs/cm	3.5	3550	3820	2350	4010	-
5	Turbidity	NTU	305	188.6	75.7	43.4	79.5	-
6	Salinity	$^0/_{00}$	1.584	1.523	1.64	0.878	1.757	-
7	Odor		Odorless	Odorless	Odorless	Odorless	Odorless	-
8	BOD_5	mg/l	12.6	21.3	24.4	18.6	20.6	<25
9	COD	mg/l	27.2	36.8	40	32	36.8	<35
10	SS	mg/l	56.0	37.0	71	6	13	80
11	Total Nitrogen	mg/l	5.5	3.92	4.6	5.2	3.8	-
12	NH_4^+ - N	mg/l	5.29	0.173	4.312	4.312	3.557	1
13	NO_2	mg/l	0.036	0.045	0.0051	0.081	0.008	0.05
14	NO_3	mg/l	0.143	0.071	0.106	0.285	0.048	15
15	Total P	mg/l	0.41	0.59	0.41	0.64	0.48	-
16	SO_4^{2-}	mg/l	2.1	5.2	1.0	41.7	2.6	-
17	Coliform	MPN/ 100ml	180	200	180	320	12	10,000

18	Fecal Coliform	MPN/ 100ml	60	102	98	122	Negative	-
19	Cd	mg/l	0.0003	0.0003	0.0004	0.0002	0.0002	0.02
20	CN	mg/l	0.005	0.001	0.003	0.003	0.003	0.05
21	Pb	mg/l	0.0028	0.0036	0.0056	0.0025	0.0072	0.1
22	Zn	mg/l	0.0548	0.0232	0.0048	0.0035	0.0012	2
23	Cu	mg/l	0.0025	0.0025	0.0037	0.003	0.0084	1
24	Cr	mg/l	0.009	0.065	0.0056	0.0047	0.0042	-
25	Cr^{6+}	mg/l	0.002	0.0015	0.001	0.0012	0.0011	0.05
26	As	mg/l	0.002	0.004	0.003	0.004	<0.001	0.1
27	Hg	mg/l	0.0003	0.0001	0.0002	0.0001	0.0004	0.002
28	Fe	mg/l	9.8	5.0	8.2	1.14	2.44	2
29	Oil	mg/l	0.16	0.18	0.2	0.14	0.16	0.3

Source: Measuring results, CCET

C.3.2.3.4 Sediment Quality

For the time being there is no Vietnamese standard for sediment and European standards are used for comparison.

Permissible Limits of Heavy Metals in Discharged Sludge

Name	Switzerland	FRG		Europe		
Medium	Sludge	Soil	Sludge	Soil	Sludge	
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/ha
Cd	30	3	20	1-3	20-40	1.5(1)
Cr	1000	100	1200	1-3	20-40	1.5(2)
Co	100					
Cu	1000	100	1200	50-140	100-1750	
Pb		100(*)	2000(**)			
Hg		2(3)	25(4)			
Ni	10	50	200			
Zn	3000(5)	300(6)	3000(7)	150-300(*)(7)	2.5-5(***)(7)	

(*) Proposed by the Government
(*) In g/ha.a
(***) In g/kg
(1) Heavy metals existing over 10 years
(2) Transported in 1 ha/a
(3) For dry soil
(4) For discharged sludge
(5) Contained in dry sludge
(6) Contained in soil
(7) Evenly spread

Source: Environmental Handbook Volume III 1995, Ministry of Economic Cooperation and Development, FRG.

Four sediment samples were taken from Lach Tray River and South-West Channel

- Location1 : Lach Tray River at Niem bridge
- Location 2: Lach Tray River, near the proposed discharging point of effluent from the WWTP
- Location 3: Vinh Niem tidal gate
- Location 4: SW channel

According to the results, concentrations of heavy metals are lower than the standard limits. Concentration of organic matter was quite high. All other indicators were within the permissible limits.

Sediment Quality of the Lach Tray River, 26/11/2000

No	Parameters	Unit	Location 1	Location 2
1	Sludge Depth	(m)	2.2	2.6
2	PH		7.3	6.9
3	Humidity	%l	43.6	47.4
4	Solid	g/kg	94.49	91.08
5	TS	g/kg	564	526
6	Apparent Density	kg/m^3	1.362	1.353
7	BOD	mg/kg	1398	1476
8	Total N	mg/kg	0.087	0.073
9	Total P	mg/kg	0.337	0.55
10	Cd	mg/kg	0.0001	0.00012
11	CN	mg/kg	$1.8x10^{-5}$	$3.0x10^{-5}$
12	Pb	mg/kg	0.008	0.008
13	Zn	mg/kg	0.016	0.017
14	Total Cr	mg/kg	0.0098	0.0115
15	Cr^{6+}	mg/kg	0.0025	0.0042
16	Hg	mg/lkg	0.000176	0.000186
17	PCB	(µg/kg)	4.8	0.4

Source: Measuring results, CCET

Sediment Quality in Tidal Gate and in SW Channel 26/11/2000

N	Parameters	Unit	Location 3	Location4
1	Water content	%	19.8	34.5
2	Total P	mg/kg	285	480
3	Total N	mg/kg	520	785
4	Oil and grease	mg/kg	4.8	5.6
5	As	mg/kg	0.22	0.39
6	Hg	mg/kg	0.17	0.31
7	Cd	mg/kg	<0.0001	0.0003
8	Pb	mg/kg	0.0083	0.0077
9	Cr	mg/kg	0.0087	0.0052
10	Cu	mg/kg	0.006	0.0085
11	Ni	mg/kg	0.0042	0.0044
12	Zn	mg/kg	0.0197	0.0063
13	Cl organic compound	mg/kg	<0.01	
14	P organic compound	mg/kg	<0.01	

Source: Measuring results, CERECE, 3/2000.

C.3.2.4 Flora and Fauna

The main terrestrial ecosystem is paddy field cultivated in 2-3 crops per year. In household gardens are grown fruits trees and vegetables for domestic purposes.

In channel and pond there are fishes as common carps, silver carps, major carps and tilapia.

Considering the land use of the area, it is evident that the ecosystem in the area is strongly affected by human activities. No endangered species or other precious species have been reported in the area.

C.3.2.5 Human Environment in Vinh Niem

C.3.2.5.1 General

The socio-economic situation of the project area was studied by CCET in November 2000. Number of questionnaires was 30. The interviews were done randomly in Village 3 and part of Village 2 in Vinh Niem commune. The detailed background data are presented in Table C.3.2.2 and 3.2.3, and summary of interview in the Data Book.

C.3.2.5.2 Land Use and Housing

The land in Village 3 is mainly agricultural and residential land. 63 % of interviewed households have in average 3-4 *saos* (1,080 – 1,440m^2, 1 *sao* = 360m^2) of land for cultivation. Fields are mainly used for growing of paddy and vegetables. It is notable that in this area there are many ponds, shared by the people for fish breeding. On the area outside of the dike there are 31 ponds, covering over 32 ha. On the river side of the dike there are 12 ponds, covering over 42 ha.

The field survey shows that the infrastructure in the project area is moderate. The residential houses have mainly one storied. The rural roads are 1- 1.5 m wide and covered with concrete. In parallel with the road there is an open irrigation channel system. The total length of this system is 1,300 m.

74 % of residential houses have been licensed and 17 % of land is owned by the State. 3% of the population lease houses. Although the land area is large, the floor area of each house is small, in average 25- 35 m^2. 80% of houses are surrounded by gardens and separate ancillary buildings. Houses have been built mainly during the last 15 years. Houses of traditional rural type still occupy a major part in the area. The people have lived here since a long time ago and have no intention to move. A small part, about 3 % of the population, are people who have immigrated from other provinces.

Households engaged in animal husbandry account for 17 %, they mainly keep pigs and hens. 10 % of households do business operation and 3.3 % of households have workshops.

C.3.2.5.3 Infrastructure

The population in the area has domestic water supply from various sources such as piped water from the public system, drilled wells, dug wells, and rainwater. 70 % of households use piped water with house connections. 23 % of households use UNICEF wells. In general the quality of drilled wells is good. These wells are in average 55 m deep, with static water level 10 m. A few households use rainwater for drinking.

Most of households (90 %) have no sewerage system. The wastewater is usually discharged into the ponds around their houses (93%) or the irrigation canals running through the village (13%). However, there are still a few households, about 7%,

letting their wastewater infiltrate into the ground. Domestic wastewater from households is discharged directly into the channels and ponds, causing organic pollution. The black water of the ponds and channels is covered by water hyacinths and floating rubbish. A thick sludge layer has been formed at the bottom of ponds and channel. Especially on the bottom of the ponds there are many yellow snails.

Over 40 % of the households in the area have flush toilets, but the wastewater from the septic tanks mainly infiltrates into the ground or flows directly to the canals. 20 % of households use double vault toilets, 13% of households use bucket toilets, and 13 % of households use open toilets. The septic tank sludge is used by the farmers as fertilizer.

According to the survey results there has be no flood in this area. The people complain about the pollution of the irrigation channel due to the flow of the wastewater from the city. The pollution is most intensive early in the morning and late in the afternoon when much wastewater flows from the city, causing unpleasant smell affecting the whole area.

The solid waste in village 3 is mainly collected and disposed by the households themselves (77%), of which 23 % of households discard their wastes into ponds and channels and 17% use the waste as fertilizer. In general solid waste is not sorted, but some households just pick up metals, paper, plastic and glass for sale. Most of households have no proper dustbins, usually they use bamboo baskets, broken buckets, wash basins, etc. Only 17% of households have plastic dustbins with covers.

C.3.2.5.4 Population

The population density of the project area is 7,500 inhabitants/km^2. The households here have 5 -6 members and usually 2-3 children.

In comparison with the education level in rural areas of Vietnam, this area has reasonable high education level. 33 % have primary school level, 33 % of secondary school level, 10% of high school level, 10% of vocational school level and 3 % of university level.

The residents in the area are mainly engaged in farming (43%), 17 % are shop keepers and the rest are mainly housewives. The pensioners and old people of village 3 account for 20%. Very few (7%) are factory workers in the city. There are very few unemployed people.

C.3.2.5.5 Household Economy

The income of the residents in this area is mainly from agriculture, accounting for 70 %, trade accounts for 27 % and other sources 20 %. The income is relatively high,

in average 726,000 VND/month/households. The reported highest income was 2,000,000 VND/month and the lowest 280,000 VND /month.

The expenditure for family living is also high, about 610,000 VND/month/household. The expenditure for food is about 390,000 VND/month. There are also expenditures for education, health, water supply and electricity supply. The water expense of households is in average 40,000 - 45,000 VND/month, some households spend 200,000 VND for water and 2,000,000 VND/month for ice production.

The households have the basic necessities, 28 of 30 households have bicycle and television, but very few households have luxury items. Only 17% of households have motorbike, 27% have video-equipment, 10% have telephone and only one household has refrigerator.

Most of the interviewees answer "No" or "I don't know" when being asked whether they spare some money to buy household appliances or to deposit in the bank saving accounts.

57 % of households would be interested to have sewer connection. 43 % of households want URENCO to collect the solid wastes. 36% want to dispose their solid waste by themselves, because they like to use the waste for filling and embanking their ponds. However, all households are ready to clean up the area where they live.

From the results of the socio-economic survey, it can be concluded that the most of the population in the area (about 63%) have average living standard. 36 % households are poor and very poor with income per person per month less than 200,000 VND. No households are wealthy or rich.

C.3.2.5.6 Health Status and Services

13 % of the residents in the area are infected with eyesores, 10 % with skin diseases and 7 % with hemorrhage fever. These diseases are mainly caused by the polluted water of the channels and ponds.

C.3.2.5.7 Environmental Awareness and Willingness to Pay

The field survey shows that 50 % of the inhabitants consider that the environment where they live is dirty, about 30 % consider it very dirty, whereas the pollution is caused by external factors. Only 13 % of households consider the environment is clean. These are the households living far away from the canal.

According to the survey people think that ponds and canals cause most of environmental pollution in the area (67 %), other reasons are wastewater (30 %) and the wastes which are not properly collected. Flies and mosquitoes are also

abundant in the area. The sludge layer in the irrigation channel system is rather thick and the small channels are usually blocked due to the rubbish and water hyacinths.

When being asked about the treatment plant construction project in the paddy field of Village 3, Vinh Niem commune, the people are in general rather worried. They are afraid to loose their cultivation land and that the treatment plant will make the area more polluted and affecting the life and the health of the people. For this reason, the compensation proposed by Vinh Niem People's Committee (11/2000) is as follows:

- Cultivation land: 100,000 VND/m^2
- Residential land: 500,000 VND/m^2
- Land affected by pollution: 20,000 VND/ m^2

C.3.2.6 Socio-economic Survey of Beneficiaries

C.3.2.6.1 General

The socio-economic survey was carried out by CCET also among beneficiaries of the project in three urban phuongs. Totally 50 interviews were done, 10 in Minh Khai phuong in Hong Bang district, 20 in Le Loi phuong in Ngo Quyen district and 20 in An Duong phuong in Le Chan district. The detailed data of interviews is presented in the Data Book.

C.3.2.6.2 Housing

All surveyed phuongs are in the urban area. Houses are either single-storied (52%) or multi-storied (38%) urban dwellings, only one interviewed household had garden. There were no semi permanent or temporary houses. Household member living in the house usually owned the house (78%). In 10 % household member not living in the house owned it. Only in 6 % the State owned the house.

Most of the houses are old, many of them constructed in the beginning of 1900. People have usually lived long time in their houses. 20% informed that they have always lived here.

C.3.2.6.3 Infrastructure

Le Loi and An Duong phuongs belong to the improved water supply area and improvement of Minh Khai phuong is going on, therefore 94% of households had house connection from Water Supply Company. Only 6% used public tank and this situation will be changed in the near future.

Also 94% informed that they have their house connected to communal sewer network. Two houses discharged their wastewater to channel or pond. 68% of the households had their own toilet and 16% shared the toilet with neighbors, and

another 16% used public toilets. Of those who had their own toilet 42% had pour flash toilet and 52% western style toilet. There were 43 septic tanks in the interviewed households, and wastewater from septic tanks is discharged mostly to sewer (91%) and in 7% directly to channel or lake. 53% of septic tanks have not been ever emptied, 25% has been emptied when needed, and only two septic tanks are emptied every year.

URENCO collects solid waste from urban area (94%), only two households throw their waste to street or vacant land and only one household throws their solid waste to channel. 58% used plastic bucket less than 10 liter with lid for their solid waste. There is no separation of solid waste at household level.

C.3.2.6.4 Population

In the interviewed households there were 161 adults and 67 children. The average number of children per household was only 1.4, which is typical for urban City center, where families have usually maximum two children.

The education level is higher than in sub-urban areas. 14% of the interviewed had university level education, 14% high school, 30% secondary school and 28% primary school. Only two persons, most probably old persons, didn't have any education.

The amount of retired persons among interviewed is high (46%). This is because most of the interviews were done during the daytime when other people where working. 14% of interviewed were civil servants, 12% had "other" occupation and unemployment rate is reasonable high (8%).

C.3.2.6.5 Household Economy

The most common income source was to work as government official (50%). Other income sources were from pension (40%) and from own business (36%). 10% had income as employee in a state enterprise. 54% of households had some kind of commercial activities. 13 household had shop, 5 households had café or restaurant, and others had offices and food production.

The informed average income of household was 1,160,000 VND, varying from 200,000 to 5,000,000 VND. The income level is much higher in the urban area than rural areas.

The average monthly expenditure per household was informed to be 1,000,000 VND. Most of the expenditures are for food about 570,000 VND/month, for education about 240,000 VND/month and for clothes about 110,000 VND/month. For water is used 30,000 VND/month, for electricity 74,000 VND/month, for telephone 135,000 VND/month and for gas 60,000 VND/month.

The households were very well equipped, 98% had TV, 92% had fan, 90% had bicycle, 76% had video equipment, 58% had motorbike, 46% had refrigerator, 34% had telephone and 32% had CD-player.

According to the estimation 52% of households have moderate living standard, 30% are wealthy, 2% are rich and 16% are poor. None of the interviewed household was classified as very poor. These results are typical for these areas.

C.3.2.6.6 Health Status

The interviewed people were in general healthy. 66% informed that they have not had any diseases during last year. No water related diseases were informed, this is because these areas belong to the improved water supply and wastewater is discharged to the sewers.

C.3.2.6.7 Environmental Awareness and Willingness to Pay

The surveyed areas are not serious flooding areas, 66% households had no problems, only two households along the channels had frequent problems.

The interviewed people considered their environment reasonable clean, 52% said that environment is clean, 42% considered it dirty and 6% very dirty. Due to the urban location the biggest environmental problem is noise (36%), dust (28%), and lack of original nature (18%). Uncollected solid waste was noticed, too, (16%).

Almost all households were connected to sewer system and 72% of interviewed supported wastewater treatment.

Table C.3.2.1 Results of Microclimate Quality Survey in Vinh Niem Commune

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
8.00 - 10.00	20.5	NE	1.88	60	Odorless
10.00 - 12.00	21.3	NE	1.01	59	Odorless
12.00 - 14.00	23.5	NE	0.98	51	-
14.00 - 16.00	23.1	NE	1.09	56	-
16.00 - 18.00	21.7	NE	0.689	53	-
18.00 - 20.00	22.3	NE	0.36	59	-
20.00 - 22.00	21.4	NE	0.253	59	-
22.00 - 24.00	21.9	NE	0.198	61	-

on 19 November 2000

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
0 - 2.00	20.3	NE	0.658	76	Odorless
2.00 - 4.00	19.9	NE	0.551	75	Odorless
4.00 - 6.00	21.3	NE	0.172	79	Odorless
6.00 - 8.00	24.8	NE	0.198	77	-
8.00 - 10.00	25.7	NE	0. 798	75	Slight
10.00 - 12.00	25.3	NE	0.879	68	Slight
12.00 - 14.00	26.0	NE	0. 851	59	Slight
14.00 - 16.00	25.3	NE	0.732	70	Slight
16.00 - 18.00	23.1	NE	0.791	65	Slight
18.00 - 20.00	23.1	NE	0.836	77	Odorless
20.00 - 22.00	23.1	NE	0.924	79	Odorless
22.00 - 24.00	23.1	NE	0.462	78	Odorless

on 20 November 2000

Date and time	Temperature (°C)	Wind direction (m/s)	Wind velocity (%)	Humidity (%)	Odor
0 - 2.00	20.5	NE	0.947	64	Odorless
2.00 - 4.00	19.0	NE	1.263	63	Odorless
4.00 - 6.00	18.3	NE	1.74	59	Odorless
6.00 - 8.00	19.2	NE	1.45	53	-
8.00 - 10.00	19.5	NE	0. 765	52	-
10.00 - 12.00	24.8	NE	0.943	38	-
12.00 - 14.00	25.2	NE	0. 755	31	-
14.00 - 16.00	26.8	NE	0.88	33	-
16.00 - 18.00	22.3	NE	0.457	38	-
18.00 - 20.00	19.0	NE	1.11	43	Odorless
20.00 - 22.00	17.6	NE	0.545	44	Odorless
22.00 - 24.00	17.2	NE	0.612	45	Odorless

on 21 November 2000

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
0 - 2.00	16.2	NE	0.291	52	Odorless
2.00 - 4.00	13.8	NE	0.272	50	Odorless
4.00 - 6.00	14.6	NE	0.176	50	Slight
6.00 - 8.00	15.0	NE	0.240	51	Slight
8.00 - 10.00	20.3	NE	0.204	49	Slight
10.00 - 12.00	26.3	NE	0.510	25	Slight
12.00 - 14.00	29.8	NE	0.420	32	Slight
14.00 - 16.00	28.3	NE	0.780	30	Slight
16.00 - 18.00	20.3	NE	0.572	54	Slight
18.00 - 20.00	19.0	NE	0.257	60	Slight
20.00 - 22.00	17.9	NE	0.595	62	Slight
22.00 - 24.00	17.9	NE	0.283	67	Odorless

on 22 November 2000

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
0 - 2.00	16.2	NE	0.114	56	Odorless
2.00 - 4.00	15.0	NE	0.323	58	Odorless
4.00 - 6.00	14.8	NE	0.252	60	Odorless
6.00 - 8.00	15.6	NE	0.238	65	Slight
8.00 - 10.00	20.5	NE	0.937ff	66	-
10.00 - 12.00	23.1	NE	1.5	58	Odorless
12.00 - 14.00	26.2	NE	0.981	54	-
14.00 - 16.00	23.8	NE	0.960	47	-
16.00 - 18.00	19.2	NE	0.540	49	-
18.00 - 20.00	19.3	NE	0.217	52	Odorless
20.00 - 22.00	18.5	NE	0.285	51	Odorless
22.00 - 24.00	18.3	NE	0.200	55	Odorless

on 23 November 2000

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
0 - 2.00	16.1	NE	0.356	58	Odorless
2.00 - 4.00	15.0	NE	0.238	62	Odorless
4.00 - 6.00	14.6	NE	0.368	66	Slight
6.00 - 8.00	16.8	NE	0.327	74	-
8.00 - 10.00	24.2	NE	0.290	52	Odorless
10.00 - 12.00	26.0	NE	0.627	36	-
12.00 - 14.00	28.5	NE	0.679	36	-
14.00 - 16.00	26.2	NE	1.26	40	-
16.00 - 18.00	22.6	NE	0.611	56	-
18.00 - 20.00	20.4	NE	0.241	60	-
20.00 - 22.00	19.8	NE	0.152	67	-
22.00 - 24.00	19.7	NE	0.191	71	-

on 24 November 2000

Date and time	Temperature (°C)	Wind direction	Wind velocity (m/s)	Humidity (%)	Odor
0 - 2.00	18.6	NE	0.182	74	Odorless
2.00 – 4.00	17.3	NE	0.218	75	Odorless
4.00 – 6.00	17.5	NE	0.232	75	Slight
6.00 – 8.00	18.4	NE	0.209	77	Slight

Source: Measuring results, CCET

Table C.3.2.2 Summary of Background Data on the Proposed Vinh Niem Wastewater Treatment Plant

Survey site	Description of the site	No of households	Population	Natural characteristics			
				Land	Ponds	Water supply	Flora
The site is located in village 3, Vinh Niem commune	* The site is located at the end of village 3 , Vinh Niem commune occupied by the paddy field of the people in village 3.	* In the site there are 18 households occupying a land area of about 12,000 m2	About 90 inhabitants	Mainly agricultural and residential land	The pond in the area cover 2.5 ha	The residents in this area have 4 drilled wells, 2 dug wells, 9 rain	* Mainly paddy, in particular along both sides of sewer canal many custard apple trees are planted
		* 18 households are			These ponds are leased to the people for fish breeding	water tanks, the rest use piped water	
	* In the West and the South it is bounded by Lach Tray river	on the land site of the dike	About 20 inhabitants			80 % of rural people use pipe water	
	* In the North it is bounded by population area of village 3						
	* In the East is a rice field				There are 12 ponds	20 % use drilled wells	
	* From Thien Loi road to the site there is a 250 m long concrete road, with residential houses on both sides	* 7 households are on the river side of the dike			on the river side of the dike, covering 42 ha	with average depth 55m, depth to static water level 10m	
	* The site is crossed by a sewer canal from the city to Lach Tray river						

	Socio-economic characteristics			Infrastructure					
Fauna	**Profession**	**Income**	**Education**	**Houses**	**Roads**	**Wire poles**	**Canal**	**Sluice gate**	**Graveyard**
In this area there are many yellow snails and rats along the sewer canal and ponds	Mainly agriculture	In average 700,000 VND /household, minimum 200,000VND /household	Primary and lower secondary	5 temporary houses , 14 class 4 houses	Concrete road , 1.5 m wide, starting from Thien Loi road, running through the village	25 poles	Sewer canal 300 m long, flowing to Lach Tray river through a gate across the dike . Irrigation canal 1300 m long	3 gates across the dike, 5 gates in the field	40 m2 wide, there are 7 graves

Environmental sanitation			Compensation rate	Opinion of the people	Evaluation by surveyors
Solid waste	Waste water	Diseases			
The solid waste are not systematically collected, but disposed of the households themselves	Mainly domestic waste water. The households near the sewer canals discharge wastewater into the canal. Some households still use basket toilets and the night soil is used for fertilizer	Mainly eye sore and alimentary diseases	Cultivation land: 100,000 VND/m2. Residential land: 500,000 VND/m2. Compensation for the land affected by environmental pollution during the construction: 20,000 VND/m2	* People complain very much about the sewer canal running across the village, especially during the dry season. The authority supports the construction of the waste water treatment plant but requires a satisfactory and reasonable compensation * Most of households do not accept the construction of the waste water treatment plant as they are afraid that they will loose their land and the environment will be more polluted, affecting their lives and health	The environment in this area is seriously polluted due to the sewer canal, especially with the smell during the dry weather The population here is not complicated, therefore if some households have to be resettled, there will not be many problems. However, attention should be paid to the compensation and arrangement of cultivation land for the people. If the waste water treatment plant, attention should be paid to the fish ponds of the people

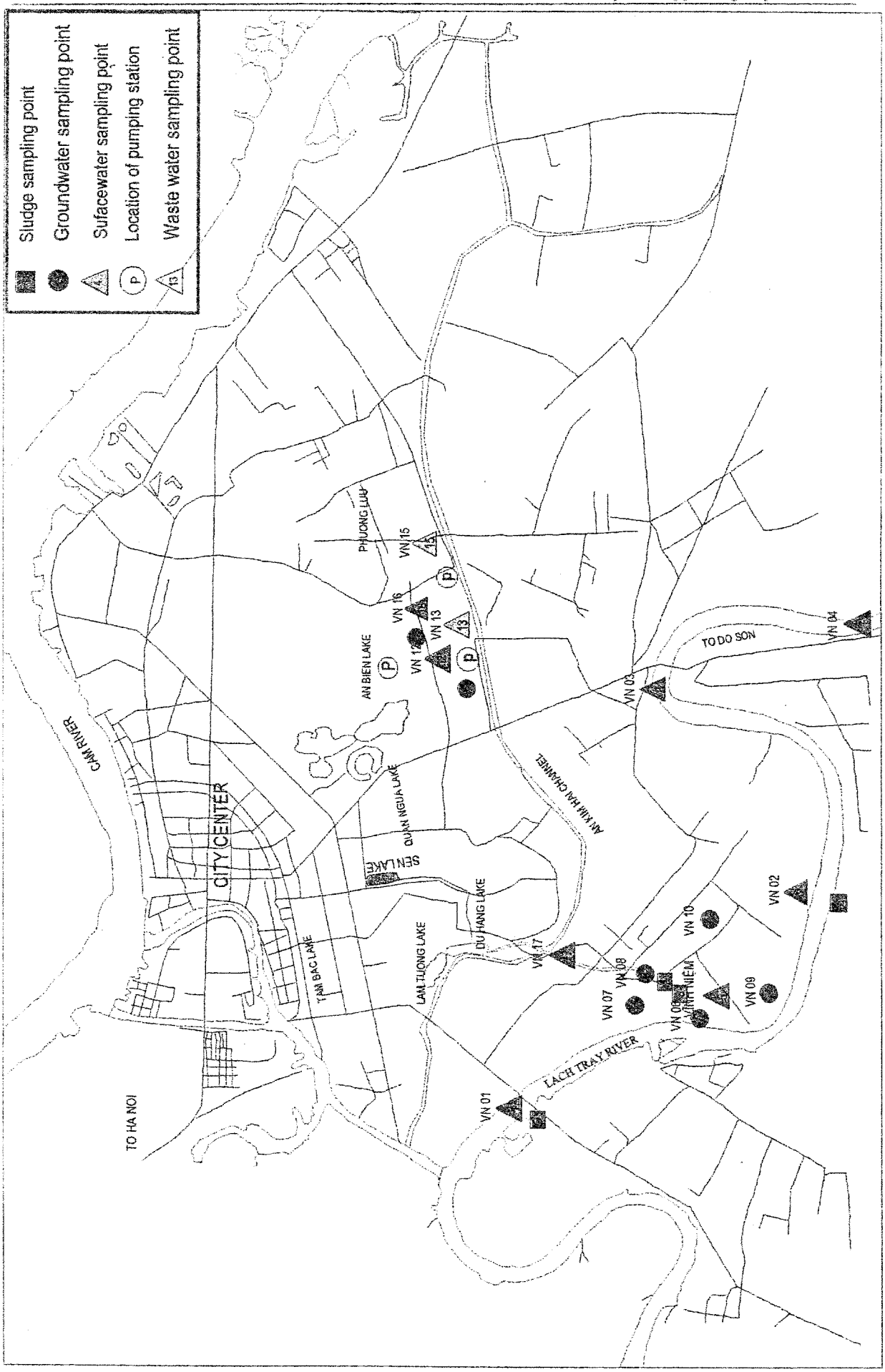
Table C.3.2.3 Summary of Background Data on the Prop[illegible]

Site description	Number of household	Natural conditions				Socio-economic conditios.		Infrastructure		Envir	Environmental sanitation	Compensation cost	Public opinion	Assessment of surveyors
		Soil	Pond	Plant	Occupation	Income	Education level	House	Road	Waste	Waste water			
*This site is in Dang Giang ward. The proposed site cover an area of 20.000 m^2.			Pond with area of 800 900m^2, there is a ditch, 3-4m deep, 100m long	Water morning-glory is mostly grown here							[illegible]	65.000 VND/m2 for flower growing land	* Agree to move on the condition that appropriate commpensation should be made.	In general, population in this area has been aware of the importance of the project
In the South is Dang Giang people founded school.	11 classes with 700 pupils	This land is previously ponds and lakes which is fill for school construction	800-900m^2				Modarate	2 two-floored houses, 2 grade IV houses, 2 flat floor houses and 1 one-floored house	Near An Da road	Seft collection of waste	Domestic waste is disposed drainage nearby ditch.	The current price is 600.000 to 900.000 VND /m^2		Site clearance is difficult
In the East is residential area with 12 households	12 households	This land is previously ponds and lakes which is fill for housing			Free labourers	700.000 - 800.000 VND/household on average.	Trung binh	2 grade IV houses, 3 flat roof house, 7 two-floored house and 1 foundation pits	1,2 - 1,5m wide concrete road	Seft collection of waste	Domestic waste water is discharged to drainage nearby ditch	The current price is 500.000 to 600.000 VND /m^2	The resident agree with suitable compensation	The people is worried that the pumping station may cause noise in the area.
In the North is residential area of An Da Ngoai village and vegetable field	4 households	This residential land is previously paddy field		Banana tree, flower and vegetable	Most of resident do farming wo	500.000 - 600.000 VND/household	Moderate	1 flat roof house and 3 grade IV houses	1,2m wide earthern road	Seft collection of waste	[illegible]	The current price is 500.000 to 600.000 VND /m^2		
In the West is drainage channel of the City.	5 households	Residential land	The channel is 3-4m wide, 100m long	Banana tree, flower and vegetable	Most of resident do farming work	700.000 - 800.000VND/household	Moderate	5 grade IV houses	1,2m wide concrete road	Seft collection of waste	[illegible]	The current price is 500.000 to 600.000 VND /m^2	* The public is wonder if the proposed treatment plant can affect the environment or not.	The people is worried that the pumping station may cause noise in the area.

Table C.3.2.3　　**（A3 版折込み裏）**

Figure C.3.2.1 Survey Location of Air Quality and Noise

Figure C.3.2.2 Location Map of Water/Sludge Sampling Point Vinh Niem Sewerge Treatment Plant



C.3.3 Present Sanitation Status

C.3.3.1 Previous and Ongoing Studies

The World Bank Sanitation Project (1B Project) consists of the following system and facility measures for sewerage improvements:

- Construction of interceptor sewers for two lakes in Class A Areas: Sen Lake in Le Chan district and Tien Nga lake in Ngo Quyen district
- Construction of septage treatment facilities at Trang Cat landfill
- Procurement of sewer cleaning and septage collection vehicles and vacuum trucks
- Revolving fund for households to purchase and install septic tanks

FINNIDA programme consists the following system and facility measures for sewerage improvements:

- Rehabilitation and construction of separate wastewater collection and treatment system in Dong Quoc Binh area in Ngo Quyen district

C.3.3.2 Sewerage and Wastewater Treatment System in Study Area

Sewage disposal in Class A Areas is based on septic tanks followed by wastewater discharge into combined sewer network. Wastewater from the combined sewer network is then discharged into the local receiving waters, including the rivers, lakes and channels.

For Class A Areas the main problems with sewage management are as follows:

- Lakes and channels are extremely polluted with poor sanitation conditions
- Septic tanks are used, but degree of treatment is not effective
- Combined sewer system is characterized by tidal water ingress into the network

C.3.4 Environmental Impacts of the Project

C.3.4.1 Approach and Methodology

All kind of construction works as well as activities related to these, will lead to certain cause (activity) and impacts on the environment. In this EIA study, we will arrange and specify both the negative and positive environmental impacts on the physical, biological and human environment caused by the construction of sewerage system, wastewater treatment plant and pumping station.

Local people's and authorities' main opinions have been recorded by socio-economic survey.

This environmental impact assessment adopts a concise format, where the linkages between environmental issues (or potential impacts), management measures (or mitigation), net effect (or residual impacts) and management information (or monitoring) are made explicitly. A comprehensive summary of these factors and their linkages is presented in the tables.

The main impacts of the proposed project are described for design phase, construction phase and operation phase. Alternative without the project implementation has been described, too.

The improvement of urban sewerage towards a clean and healthy environment for the population of Haiphong City is essential. The overall impact of the proposed project is positive and it is an important step in improvement of sewerage system improvement in Haiphong.

C.3.4.2 Without-Project Alternative

(1) Considered Cases

Pollution loads to the environment[1] in 2010 were estimated for the following cases (also see Section 10.5, Part 2 of Main Report and Section on project evaluation of Sewerage Priority Project)

[1] Pollution load to environment does not include natural reduction (self-reduction) of pollution load (e.g., microbial decomposition, sorption) in the environment.

Considered Cases and Assumptions

Case	Assumptions
Without Project	- No project is implemented - Generated pollution loads are directly released to the environment without treatment
Without JICA Project	- WB 1B Project will be implemented - Wastewater is primarily treated with septic tank - Proposed JICA Sewerage Priority Project will not be implemented
With JICA Project	- JICA Sewerage Priority Project will be implemented - Wastewater is collected and treated at the proposed Vinh Niem WWTP.

(2) Estimation Methods

1) Pollution Load Generation

Pollution load generations from the following sources were considered: domestic, industrial, commercial institutional, and non-point sources. Details of the estimation methods were discussed in Section 10.5 of the Master Plan.

2) Reduction of Pollution Loads

1) Collection System

The efficiency of combined sewer system to collect pollution load is not 100 % because combined sewer overflow (CSO) contains substantial amount of pollutants. The following first-cut estimates of collection efficiency were assumed based on the precipitation pattern and collection efficiency of similar system.

Efficiency of Sewage Collection Systems

unit:%

System	BOD	SS	T-N	T-P
Combined	90	80	90	90

It was assumed that the remaining part of the pollution load, i.e., pollution load released from CSO control structures, is directly released to the environment.

2) Treatment System

Table below summarizes the estimated efficiency of treatment systems.

Efficiency of Treatment Systems

unit:%

Treatment	BOD	SS	T-N	T-P
WWTP	80	80	15	15
Septic Tank	25	30	0	0

WWTP: Wastewater Treatment Plant (aerated lagoon or equivalent)
source: WHO (1993), Japan Sewerage Assoc. (1997), Metcalf & Eddy, 1991; modified by the JICA Study Team

The proposed WWTP is designed to meet the effluent quality of BOD 50 mg/l (see Sewerage Section). Assuming the inflow BOD concentration of 350 mg/l, the efficiency of the WWTP to remove BOD would be in the order of 85%. However, the inflow maybe weaker due to seepage of groundwater into the sewer system. In addition, stormwater collected from combined system will be discharged after primary treatment if its volume were larger than the design capacity. Considering these factors, the average BOD removal efficiency of a WWTP was estimated at 80 %. Similar estimates were made for other pollutants on the basis of the typical removal efficiency of similar systems. Septic tank was assumed to receive only black water.

(3) Estimated Pollution Loads

Table below summarizes the anticipated generation of pollution loads.

Anticipated Generation of Pollution from Priority Project Area in 2010

Pollutant	Unit	Point Source*	Non-Point Source	Total
BOD	kg/day	13,099	336	13,435
SS	kg/day	12,148	4,577	16,725
T-N	kg/day	2,551	188	2,739
T-P	kg/day	275	113	388

* : domestic+industrial+commercial+institutional

Table below compares the estimated pollution load for each case.

Estimated Pollution Load to Environment in 2010

Pollutant	Unit	No-Project		Without JICA Project		With JICA Project	
BOD	kg/day	13,435	(100 %)	10,160	(76%)	3,762	(28%)
SS	kg/day	16,725	(100 %)	13,081	(78%)	6,021	(36%)
T-N	kg/day	2,739	(100 %)	2,739	(100%)	2,369	(86%)
T-P	kg/day	388	(100 %)	388	(100%)	336	(86%)

As it is evident from this Table, substantial amounts of pollution loads will be released to the environment. Even if the wastewater is treated with septic tank, the pollution loads to the environment will be still sizable.

C.3.4.3 Environmental Impacts during Design Phase

During pre-construction phase, land acquisition, resettlement and site clearance will have the biggest impacts. The results of preliminary survey show that total number of households to be affected will be 23, including 6 temporary houses, 17 grade IV houses and 260 m^2 of auxiliary facilities. There are many public facilities in the area, such as 25 civil electricity pillars, 7 graves (graveyard area of 40 m^2), 300 m of wastewater canal, 1,300 m of irrigation canal, 5 sewers, 200 m of 1 m wide asphalt field roads.

The relocation of dyke will cause local but temporary disturbance to the farmers who have fishponds inside and outside of the dyke.

Site clearance will create the following environmental impacts and pollution:

- Land compensation and resettlement
- Dust generated during removal of houses, structures and infrastructures, loading, unloading and transportation of excavated materials
- Construction materials to be disposed such as broken bricks, concrete, etc.

Land acquisition and resettlement will create temporary disturbance to people's lives. Resettlement will make people worried, causing troubles and possibly breaking the relationship between migrating and staying ones. This will be even bigger problem in rural than urban area. Therefore it is recommended that resettlement of project affected people should be arranged to the nearest possible vicinity of their existing houses.

C.3.4.4 Environmental Impacts during Construction Phase

C.3.4.4.1 General

(1) Vinh Niem Wastewater Treatment Plant

Major activities causing environmental pollution will be:

- Removal of the dyke
- Construction of WWTP

The potential environmental impacts of these activities are as follows:

- Dust from the excavation of WWTP lagoons
- Exhausted gas from construction machines and means of transportation during construction, possible oil and lubricant spills
- Noise and vibration from construction and transportation

(2) Conveyances, Trunks and Laterals

During installation and construction of conveyances, trunks and laterals following short-term impacts will be created:

- Excavation from deep trenches along the streets
- Transportation of excavated materials and filling materials
- Exhaust gases from construction machines and transportation vehicles
- Noise and vibration from construction machine and vehicles
- Possible oil and lubricant spills from machines
- Disturbance of local traffic during construction

(3) An Da Pumping Station

One pumping station will be built with relatively small area (3,800m^2) in An Da Ngoai village. The proposed area is water plant ponds and there is no need for resettlement. The impacts on the environment will be short-term, causing only local nuisance from construction and transportation of materials.

C.3.4.4.2 Impacts on Air Environment

Excavations and transportation of excavated materials will cause air pollution due to the dust and exhausted gases from machines and trucks. However, the influence of exhausted gases will be small, local and temporary.

The construction of the sewer system and the excavation of soil for the construction of the facilities for WWTP will last a short time, concentrated mainly in Village 3 of Vinh Niem commune. In general noise pollution will be low and will occur only during a short time near the construction sites and along the road run by the trucks carrying earth material and construction materials.

C.3.4.4.3 Impacts on Water Environment

During construction, excavation and leveling there is a risk of infiltration of surface water and wastewater into groundwater and local contamination of groundwater is possible. This is a risk especially during excavation of deep trenches for different kind of sewers. According to the geotechnical surveys the upper aquifer will not be disturbed in the construction site of wastewater treatment plant.

Construction and excavation do not have big straight impacts on surface water.

C.3.4.4.4 Impacts on Soil Environment

During the construction the following amount of earth will be excavated:

- Amount of debris from demolished houses and other structures for site clearance for the construction of the treatment plant is estimated to be 10 m^3

- Earth excavated to remove the current dyke towards Lach Tray River.[2].
- Amount of earth material excavated during the construction of the sewer network and the aerated lagoon is estimated to be about 420,000 m^3 (preliminary estimate)
- The oil spill from the mechanized equipment operating in the site and along the road will be insignificant, and should not cause serious soil pollution

The earth excavated from the WWTP construction site is fertile soil from the paddy field, and can used further for agricultural use or for ground filling in the vicinity of construction site thus decreasing the need of long transportation.

Part of the excavated material from sewer construction can be used as filling of trenches

C.3.**4.5 Environmental Impacts during Operation Phase**

C.3.4.5.1 General

During the operation of the wastewater treatment plant the environmental impacts will be the following:

- Offensive odor from WWTP
- Gases generated from the operation of WWTP (CH_4, H_2S, NH_3)
- Change of the water quality in effluent discharging point in the Lach Tray River
- Solid wastes collected from screens of WWTP and grit chambers of CSOs

However, besides the adverse impacts the wastewater treatment will have considerable positive impacts on the environment and health situation of the city:

- Decreasing of pollution level of wastewater before being discharged to channels, rivers and sea
- Decreasing rate of water related diseases
- Improvement of water quality of lakes, channels and rivers, thus improving the living condition of people living next to these water bodies

C.3.4.5.2 Impacts on Air Environment

Waste gases produced in the operation phase are mainly from anaerobic decomposition process of organic substances in wastewater. The typical gases generated from treatment process are: CO_2, NH_4, H_2S. However, these gases easily disperse into the air and cause minor pollution

Concentration of these gases depends on the content of substances in wastewater. With designed capacity of 40,000 m^3 impacts on surrounding communities will not be avoidable, and there will especially offensive odor.

[2] According to a preliminary estimate, the volume of the excavated soil will be roughly 22,500 m^3.

C.3.4.5.3 Impacts on Water Environment

(1) Assumed Condition

The following conditions were assumed in order to assess the environmental impact of the effluent from the proposed WWTP on the water quality of Lach Tray River under the "worst-case" scenario.

1) Operation of WWTP

The WWTP is operated at the design capacity (40,000 m^3/d).

2) Effluent Concentration

The WWTP was designed to meet the TCVN 5945-1995. The assumed effluent concentrations of the pollutants are as follows:

Assumed Effluent Concentration

Treatment	Unit	BOD	SS	T-N	T-P
Raw Wastewater	mg/l	355	340	65	8
After Treatment	mg/l	50	50	55	7
TCVN 5945-1995	mg/l	50	100	-	-

Preliminary estimate by the JICA Study Team

3) Receiving Water

The following background conditions (water quality and discharge level) upstream of the discharge point were assumed based on the existing discharge and water quality data. The discharge level was set at roughly 25-percentile of the estimated average seaward flow to assess the water quality in dry season. In dry season, the dilution capacity of the river is lower than in rainy season.

Background Conditions

Parameter	Unit	Lach Tray
Discharge	10^3 m^3/day	3,000
BOD	mg/l	10.0
SS	mg/l	120.0
T-N	mg/l	1.00
T-P	mg/l	0.70

(2) Anticipated Pollution Level

Table below shows the anticipated concentrations of pollutants. The concentrations of pollutants were calculated by dividing the pollution loads by discharge[3].

[3] Complete mixing was assumed in the calculation.

Anticipated Water Quality of Lach Tray River

Pollutant	Unit	Anticipated Conc.	TCVN 5942-1995
BOD	mg/l	10.7	25
SS	mg/l	121	80
T-N	mg/l	1.73	15*
T-P	mg/l	0.81	-

* : as nitrate
** : TCVN 5942-1995

As it is clear from this estimate, the change in water quality of Lach Tray River will be limited, mainly because the discharge level of Lach Tray River is nearly 100 times larger. According to this calculation, TCVN 5942-1995 will be satisfied except for SS, which is high in the background.

It should be noted that the estimate given above is based on "net" seaward flow. However, hydrological condition of Lach Tray River near the proposed discharge point is strongly tidal, and diurnal tidal flow is the dominant mechanism of local transport in short-time frame. Further analysis of environmental impact is recommended in the Detailed Design Stage.

C.3.4.5.4 Impacts on Soil Environment

Solid waste will be collected from screens of the WWTP. Currently, due to low awareness on environmental sanitation people dump solid waste into sewers and volume of solid waste in sewers is big.

According to URENCO's calculation, the volume of solid waste collected depends on flow of wastewater being from 0.001-0.002m^3/m^3. Based on this waste volume collected from screens would be 40-80 m^3/day.

The sludge generated from the treatment process will be dried at the sludge drying bed in the WWTP. The amount of dried sludge will be about 40 m^3/day.

C.3.4.5.5 Impacts on Human Environment

According to the set targets, the project will contribute improving the urban sanitation conditions, limiting spreading of diseases as well as improving water quality before discharging to the Lach Tray River.

- The implemented project will create more employment for residents, at the same time enhance the community awareness on environmental protection.
- For aesthetic aspect, the project contribute making the City more beautiful, shaping a civilized urban ways of living and creating a sense of responsibility

and entitlement for each citizen on environmental protection on the basic of environmental fee payment

C.3.4.6 Summary of Environmental Impacts of the Sewerage Project

C.3.4.6.1 General

The anticipated positive environmental impacts of the proposed sewerage project are: (i) improvement of sanitation and public health condition and (ii) up to 80 to 100% reduction of pollution loads to lakes and channels in the project area.

The biggest adverse impacts during the project implementation are: (i) land acquisition and resettlement of about 23 households and some other structures, and relocation of dyke (ii) limited pollution level increase of the Lach Tray River, (iii) disposal of treatment sludge, and (iv) offensive odor from the WWTP.

Assessment Advantages and Disadvantages of the Project to Living Environment in City Center

Causes	Impacts		Time scale	Need for mitigation
	Positive	Negative		
Dust from construction, traffic		- -	Temporary	Yes
Noise during construction.		- -	Temporary	Yes
Traffic jam during construction, transportation		- -	Temporary	Yes
Risk of soil and ground water contamination		-	Long-term	Yes
Gases from treatment process		-	Long-term	Yes
Health risk for worker		-	Temporary	Yes
Affect on cultural, historical aspect	+	-	Temporary	No
Employment creation	+		Temporary	No
Usage of sludge as fertilizer	+		Long-term	Yes
Recycle of sludge for landscaping	+		Long-term	No
Reduction of health risks due to improvement of sewerage system	+ + +		Long-term	No
Reduction of wastewater related diseases	+ + +		Long-term	No
Improvement of health of city community	+ + +		Long-term	No
Improvement of city's aesthetics	+ + +		Long-term	No

Legend:

- - - Very negative - - Negative - Less negative
+ Less positive + + Positive + + + Very Positive

Assessment of Advantages and Disadvantages of the Project to Vinh Niem Commune

Cause	Impact		Time scale	Need for mitigation
	Positive	Negative		
Acquisition of 38 ha of land and relocation of 23 households		- - -	Long-term	Yes
Odor nuisance from WWTP		- - -	Long-term	Yes
Discharge of treated wastewater to Lach Tray River affecting water quality		- - -	Long-term	Yes
Generation of wastewater related diseases		- -	Long-term	Yes
Solid waste and sludge collected from treatment plant		- -	Long-term	Yes
Dust from transportation, construction		- -	Temporary	Yes
Safety for workers		-	Temporary	Yes

Traffic jam during construction, transportation		-	Temporary	Yes
Exhausted gases generated from construction		-	Temporary	No
Noise from pumping station		-	Long-term	No
Social order and security		-	Temporary	Yes
Influences on aesthetics		-	Long-term	No
Influences on cultural, historical aspect	+	-	Temporary	Yes
Creation of employment	+		Temporary	No
Environmental awareness for community	+ +		Long-term	No

Legend:
- - - Very negative - - Negative - Less negative
+ Less positive + + Positive + + + Very Positive

The above tables show that the positive aspects of the project exceed the negative ones. Although there are long-term negative impacts those can be minimized with mitigation measures and good management of operation and maintenance of the WWTP.

The major environmental impacts for Vinh Niem WWTP are presented more detailed in Table C.3.2.4.

Table C.3.2.4 Summary of Major Impacts and Mitigation Measures for Vinh Niem Wastewater Treatment Plant

Issue	Location	Major Impacts	Mitigation Measures	Net Effect	Monitoring
Construction					
Sewer system	Along main streets	Temporary impacts during construction. No need for resettlement or permanent land acquisition. Possible contamination of upper aquifer during the construction of trunks.	Works should be designed and timed to minimize the impacts on traffic. Possible infiltration of groundwater to trench has to be prevented. The slopes of open trench has to protected to avoid land slides.	Major, but temporary impacts	Construction supervision consultant has to supervise that agreed measures are implemented
Pumping station	Paddy field in An Da	Temporary impacts during construction. No need for resettlement. Small area for permanent land acquisition.	Works should be designed to minimize the impacts on surrounding areas.	Minor permanent impact	Construction supervision consultant has to supervise that agreed measures are implemented
WWTP	Agricultural area in Vinh Niem	Land acquisition of about 38 ha. About 23 households, 7 tombs, 5 small tidal gates and 25 power poles need to be removed. Relocation of dyke and road.	Resettlement Action Plan has to be done outlining principles and regulations for compensation and resettlement of project affected people. Resettlement is proposed to be done in Vinh Niem villages in the vicinity of construction site. Lagoons should be constructed without disturbing groundwater. Lining of lagoons has to be done tight to prevent infiltration of wastewater to soil and groundwater.	Long-term impacts on project affected people and landscape	Detailed measurement survey and information to residents.
Pollutants	Near construction equipment	Possible spills of oil, grease, solvents and fuel.	Discharge of pollutants to soil must be prohibited, and proper disposal has to be arranged.	Minor local impacts	Not needed
Noise	Near construction equipment on sewer, pumping station and WWTP construction sites	Noise is local and short term during the construction and transportation of construction material.	Avoid working in residential area at night. Mitigate noise during construction by using anti-vibration tools or noise insulation. Workers should use of protective tools when noise exceeds 85dB.	Short term local impacts	Not needed
Dust	Along the transportation roads	Dust generated mainly during transportation of construction materials	Effective management of transportation and unloading. Transportation trucks should be covered	Considerable, but temporary impacts	Supervising of transportation

Issue	Location	Major Impacts	Mitigation Measures	Net Effect	Monitoring
	and in the construction sites	and excavated soil.	to prevent accidental spill of soil. Watering in construction area in order to control dust.	at poor quality roads during transportation	and unloading
Air emission	Near construction and transportation equipment	Volumes of NOx, COx, CO_0, CH_4, H_2S and dust particles from construction equipment and transportation vehicles will have minor and local impact and short term minor greenhouse gas effect.	Mitigation measures are not necessary.	Minor local impacts	Not needed
Operation					
Major pollutants	Discharging of effluent	Discharging of treated effluent will slightly increase the pollution load to the Lach Tray River, increase of BOD, nutrients and bacteria	Prohibited to bypass untreated wastewater straight to the river. Discharging of effluent should be timed according to the tidal system.	Minor but permanent impacts	Monitoring of treatment process and effluent quality
	Air emissions and odor generated during wastewater treatment process	CO, CO_2, CH_4, H_2S, NO_2 and odor generated from treatment process will have local, long-term impacts on air environment in Vinh Niem area.	It is recommended to plant trees around the WWTP to minimize the impacts of odor and gases.	Minor but permanent impacts	Monitoring of air quality
	Sludge drying beds	Leachate from sludge beds	Leachate should be circulated to treatment process. Dried sludge can be used as fertilizer, if the concentrations of heavy metals are under acceptable limits or disposed to landfill.	Long-term impacts if no appropriate mitigation measures adopted.	Monitoring of sludge

Impacts of the Sewerage Project on Haiphong People

Adverse impacts

Construction Phase	Dredging of sludge, Excavation of soil
	Construction of trunks
	Transportation of excavated material
	Construction of WWTP
Operation Phase	Effluent, Gas and odor from WWTP, Sludge treatment
Positive impacts	Improvement of sanitation situation
	Improvement of health conditions

Impacts of the Sewerage Project on Vinh Niem People

Adverse impacts

Construction phase	Dyke removal,
	Excavation of aerated lagoons
	Construction of WWTP and road
Operation Phase	Gas and odor from WWTP
	Effluent, Sludge treatment
Positive impacts	New road
	Possible new work places

C.3.5 Mitigation Measures

C.3.5.1 Mitigation Measures during Design Phase

C.3.5.1.1 General Design Instructions

Environmental matters have to be integrated in all the design work and planning of the project. The designing has to be done by minimizing the adverse impacts on environment using as much as possible existing facilities and selecting the location of new facilities in areas where the disturbance to environment, people and existing structures is the smallest. Where possible existing rights-of-way has to be used rather than create new ones.

According to the Vietnamese Construction Regulation Standard Article 3.3 Protection of Natural Resources and Environment construction projects should:

- Not cause adverse effect to environment, and technical regulations on scenery and environment protection should be observed;
- Protect the natural preservation areas, and historical, cultural and architectural places;
- Extracting natural resource must ensure the rationality and cause no obstacle to the next exploitation;
- Respect traditional customs, practices, religions of people living in and around the construction area.

In Construction Regulation Standard there are general instructions for designing sewerage system. Urban sewerage system should be assured:

- Discharge all types of urban wastewater
- Have suitable solution for treating wastewater so that urban area is not flooded, and environment and water sources are not polluted

In Standard Branch Sewerage and Drainage System and Works, Standard Designs there are more detailed design instructions. However, international design standards have to be introduced and used in design work.

C.3.5.1.2 Sewerage Design Instructions

The conveyances will be constructed in deep trenches and special attention has to be paid to other underground structures and level of upper aquifer.

To prevent possibility of contaminating water supply system, a strategy of protection of water pipelines during the construction of sewers has to be prepared. A special attention has to be paid if there are crossing of sewer and water pipe. It is not allowed to have water pipes going through the sewer manholes or box culverts.

C.3.5.1.3 Land Acquisition and Resettlement Sites

Detailed measurement survey has to be conducted and exact number and type of houses and infrastructure to be relocated has to be identified. Land acquisition and resettlement has to be done according to the approved resettlement procedures described in Resettlement Action Plan to be prepared during the detailed design phase of the project.

According to the preliminary estimation about 23 households should be relocated. Resettlement is proposed to be done in the villages in the vicinity of the project area.

Location and size of resettlement areas has to be decided during the detailed design phase, and design the necessary infrastructure and other structures.

Relocation of the existing dyke has to have permission from Dyke Management Board. The proposed new dyke must ensure good condition, safety in flood seasons and be constructed under supervision of dyke management staff. Before removal, careful examination and survey of the dyke foundation is needed.

C.3.5.2 Mitigation Measures during Construction Phase

C.3.5.2.1 Noise, Odor, Litter and Dust

Maximum permitted noise level in public and residential areas is given in Vietnamese standard TCVN 5949-1995. The strongest limitations are from 10 p.m. to 6 a.m. in the vicinity of hospitals, sanatoriums, libraries and kindergartens where maximum noise level is 40 dB.

In construction sites dust, litter and public inconvenience has to be minimized by good construction management and site supervision. To minimize dust emissions caused by construction works, sprinkling the streets with water is recommended in the vicinity of construction sites.

It is extremely important to inform the local people in advance about the public nuisance during the construction and other works.

C.3.5.2.2 Groundwater Quality

During construction of sewers changes in quality of soil and water spraying to trench should be followed to identify changes of geotechnical layers. Special attention has to be paid to prevent groundwater contamination and infiltration of groundwater to the trench.

During construction, oil and waste from transportation trucks and machines need to be collected and disposed in the suitable place to avoid water pollution.

C.3.5.2.3 Health and Safety

In all construction works local health and safety working methods and instruction given in project documents have to be followed up.

(1) Safety, Security and Protection of the Environment

The Contractor shall, throughout the execution and completion of the works and remedying of any defects therein:

- Have full regard for the safety of all persons entitled to be upon the site and keep the site and the works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons.
- Provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and
- Take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

(2) Accidents and Insurance

The Employer has no responsibility for injuries that may be suffered by employees of the Contractor, unless such injury results from an act or default of the Employer. In such circumstances the injured person would be regarded as a "third party" to the Employer and the Employer would have the benefit of the Third Party insurance.

During the execution of the works the Contractor shall keep the site reasonably free from all unnecessary obstructions and shall store or dispose of any Contractor's equipment and surplus materials and clear away and remove from the site any wreckage, rubbish or temporary works no longer required.

The Contractor shall have on his staff at the Site an officer dealing only with questions regarding the safety and protection against accidents of all staff and labor. This officer shall be qualified for his work and shall have the authority to issue instructions and shall take protective measures to prevent accidents.

(3) Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labor and, in collaboration with and to the requirements of the local health authorities, to ensure that medical staff, first aid equipment and stores, sick bay and suitable ambulance service are available at the camps, housing and on the Site at all times throughout the period of the Contract and that suitable

arrangements are made for the prevention of epidemics and for all necessary welfare and hygienic requirements.

The Contractor is responsible to provide appropriate equipment, tools and protective clothing to the workers. The Contractor has to ensure that appropriate working methods are applied.

Anti-vibration mountings and noise insulation on equipment has to be used when possible. The Contractor has to provide and train how to use ear protectors for workers when noise level in the working place exceeds 85 dB.

The removed material from construction sites has to be handled, transported and disposed according to the safety instructions.

(4) Safety and Health during Sewer Construction

The Contractor has to follow strictly safety and health regulations during construction of especially deep laid conveyances and during transportation of excavated material. During the tunnel excavation there have to be at least one top man, who must maintain a contact with workers, and in case of troubles, know who is in the confined space and recognize early signs of danger.

A possibility to proper washing with clean water has to be arranged during and after the working.

Clean water and first aid kit has to be available to wash and treat the possible cuts and wounds.

C.3.5.2.4 Traffic and Transportation Arrangements

(1) Interference with Traffic and Adjoining Properties

All operations necessary for the execution and completion of the works and the remedying of any defects therein shall be carried on so as not to interfere unnecessarily or improperly with:

- The convenience of the public
- The access to, use and occupy public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

The contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors. In particular, the Contractor shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, plant, Contractor's equipment or temporary works from and to the site shall be limited, as far as reasonably possible.

(2) Transportation of Excavated Materials

The nuisance caused by transportation of materials has to be minimized by arranging transportation and construction on busy main streets only outside rush hours and in narrow streets in residential areas only during the day. The transportation has to be avoided between 10 p.m. to 6 a.m. and is allowed only on the request of traffic police. The noise level limitations given in the Vietnamese standard TCVN 5949-1995 have to be followed.

Careful planning of construction and transportation schedules, and planning and selection of routes, as well as choice of transportation vehicles will minimize dust.

Loads have to be covered tightly to minimize spread of dust and preventing dropping of material from the loads to the roads.

Excavated earth from Vinh Niem WWTP construction site should be used for agricultural or for ground filling in the vicinity of construction site. At least part of the excavated material from sewer construction can be used as backfilling of trenches.

C.3.5.2.5 Working Time and Site Arrangements

(1) Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Engineer, proposed Site regulations for the Employer's approval, which approval shall not be unreasonable withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the facilities, gate control, sanitation, medical care, and fire prevention.

Sign to show the name of the Project, the name of Employer and the name of Contractor has to locate in visible place in the construction site.

(2) Site Clearance

Site Clearance in course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

Clearance of the Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and

debris of any kind from the Site, and shall leave the Site, and shall leave the Site and Facilities clean and safe.

(3) Watching and Lighting

The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

(4) Work at Night and on Holidays

Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Engineer.

C.3.5.2.6 Public Relations

The Employer shall announce the construction works and new traffic arrangements during rehabilitation works to the public regionally in newspapers, TV and radio. Locally the announcement is given to the phuong representatives who will inform the residents. Loudspeakers can be used during the construction work to give the latest information in concerning areas. It is extremely important to inform the local people in advance about the public nuisance and especially possible traffic problems during construction of sewers.

C.3.5.4 Mitigation Measures during Operation phase

C.3.5.4.1 General

The Employer has the responsibility to carry out all operation and maintenance work. The Employer has responsibility to arrange all operation and maintenance work using proper methods and avoiding noise, odor, litter, dust and traffic nuisance during the operation.

The same health and safety instructions as during the construction phase have to be followed also during operation phase when cleaning of channel and lake. Protective clothes have to be provided to all workers. A possibility to proper washing with clean water has to be arranged during and after working.

C.3.5.4.2 Operation and Maintenance of Wastewater Treatment Plant

(1) Gases and Odor from Treatment Process

During the operation of WWTP gases as CH_4, CO, H_2S will be generated. To prevent spreading of gases and offensive odor at least 20m wide green belt with trees should be planted around the treatment plant.

(2) Effluent

Effluent has to meet the Vietnamese Standard TCVN 5945-1995 Column B before being discharged to the river. According to the designed capacity, the daily capacity of the plant is 40,000 m^3/day. To avoid scouring of the riverbank by the effluent from the WWTP, discharge gate should be designed suitably to the flow regime of the river. The discharge point should be placed 100-200m the downstream and the pipe should be under water to prevent erosion of the banks.

Sludge from sludge from sludge drying beds can be used as fertilizer, if the heavy metals are under permissible limits. If the limits are exceeded, sludge should be disposed at landfill. Leachate from sludge drying beds has to be circulated to the treatment process.

(3) Education and Training

The Employer should arrange annual training courses to improve the skills of operation staff. This training should be part of the normal operation & maintenance practices and budget.

C.3.5.5 Impacts with the Proposed Mitigation Measures

All of the proposed mitigative measures were designed to satisfy relevant environmental laws and regulations. Hence, the environmental impacts will be sufficiently minimized to the acceptable levels as long as these measures are implemented as planned. Details of the mitigative measures should be designed in the Detailed Design phase in order to reflect the details of the project design in the mitigative measures.

C.3.5.6 Summary of Mitigation Measures

Phase	Main mitigation measures	Responsible organization
Design	International and Vietnamese design criteria and standards to be used Underground structures have to be identified before construction of conveyances and other sewers Relocation of the dyke in Vinh Niem has to be designed Works designed to implemented during dry season	Design Consultant
Construction	Minimize dust, odor, litter, noise and traffic emissions by good	Contractor

	operation management and site supervision Appropriate working methods have to be followed Groundwater contamination and infiltration to trenches has to prevented during construction of conveyances Sites have to be kept clean and safe during and after the work Safety and health regulations has to be strictly followed Protective clothing and operational training for workers is essential Transportation has to be minimized and routes selected to avoid public nuisance Transportation during rush hours and night has to be avoided Construction sites and time has to be informed to the local people in advance	
O&M	Minimize odor, litter and noise emissions by good operation management and site supervision Appropriate working methods have to be followed Sites have to be kept clean and safe during and after the work Safety and health regulations have to be strictly followed Protective clothing and operational training for workers is essential	PIO

C.3.6 Land Acquisition and Resettlement

According to the preliminary survey done in November 2000 by CCET the total number of households to be relocated in the project area is 23, of which 6 are temporary houses and 17 houses of grade IV. The grade IV houses have a total area of 680 m^2, and the temporary houses 200 m^2. The auxiliary building area is 260 m^2. The total land area is about 38,000 m^2, of which 25,000 m^2 are fish ponds including to the cultivated land and 14,700 m^2 are residential land. In the area there are 25 electrical posts, 5 irrigation gates, 7 tombs and 200 m of 1 m wide asphalt road.

Estimated compensation is as follows:

Item	Quantity	Unit price USD	Total price USD
Long term residential land	14,700 m^2	28	411,600
Cultivated land	365,300 m^2	3	1,095,900
Temporary houses	200 m^2	20	4,000
Class 4 houses	680 m^2	48	32,640
Auxiliary buildings	260 m^2	25	6,500
Masonry tombs	7 tombs	100	700
Sluice gates	5 gates	150	750
Fruit trees	350 trees	3	1050
Compensation for infrastructure	23 households	100	2,300
Allowance for migration	23 households	65	1,495
Allowance for recovery of income	23 households	65	1,495
Allowance for difficulty during the migration	23 households	400	9,200
GRAND TOTAL			1,567,630

Total compensation for the construction of the treatment plant is estimated to be 1,567,630 USD.

The quantities are based on survey results of CCET in 11/2000 modified slightly according to the changes in design. The unit prices are taken from feasibility study of An Kim Hai improvement project prepared by SADCo.

Land acquisition and resettlement of people to the new settlement areas will create a temporary disturbance to their life causing worries and breaking the relationship between the migrating and staying people.

The land acquisition will affect the production and properties of the people and their income from the land. The affected people will be compensated for the properties lost and will be provided with assistance to restore or at lest to maintain their living standard and income as before the project.

There is willingness to migrate and delivery of land according to the schedule, but there might be some delays due to people who do not support the project. Therefore

authorities of Vinh Niem commune have to have suitable policy to settle problems during the land acquisition and resettlement.

The biggest change will be to the 9 households who are using the fishponds in the area. The other households are engaged in agriculture and fishing in Lach Tray River. There is a need to create new jobs for these people.

For the seven tombs, which have to be relocated have to find spiritually suitable place in the vicinity of the villages.

Land acquisition for pumping station will be 11,400 USD and relocation of dyke has been estimated to be 586,239 USD.

The total amount for land acquisition and compensation is estimated to be 2,165,269 USD.

C.3.7 Monitoring Programs

C.3.7.1 General

C.3.7.1.1 Objectives

The objective of the project is to collect information on the changes of environmental quality due to project implementation so as to timely identify adverse impacts to the environment and propose of mitigation measures for prevention of environmental pollution. On the other hand, environmental monitoring also aim to ensure the safety of project operation.

C.3.7.1.2 Content

To environmental monitoring programs for the project include:

- Monitoring of project affected people
- Monitoring of air environment
- Monitoring of water environment (surface water, ground water)
- Monitoring of treatment process
- Monitoring of treatment sludge

C.3.7.2 Monitoring of Project Affected People

In order to fully understand the benefits of the project and to enhance public awareness on environmental protection in Vinh Niem monitoring of project affected people is needed.

The location for monitoring is typical residential areas around Vinh Niem WWTP. The number of interviews proposed to be 30 selected randomly.

The content of monitoring will, to some extend, be similar to that of socio-economic survey. However, it should focus more on the project‘s impacts to the environmental quality, community health and employment of people and environmental status during the operation of the sewerage treatment plant.

Monitoring will be carried out twice per year. The first interview should be carried out one month after the WWTP has been in operation. Based on the survey results and summing up of public opinion, shortcoming of the project should be mitigated.

C.3.7.3 Air Quality Monitoring

Air monitoring will be carried out in the project area, its vicinities and affected residential areas. It is proposed to have four location of ambient air monitoring as follows:

- 1 monitoring point inside WWTP.
- 3 monitoring points in the surrounding villages

Ambient Air Quality Monitoring Indicators

No	Indicator	Air monitoring station	
		Inside	Outside
1	SO_2	*	*
2	NO_2	*	*
3	CO	*	*
4	CH_4	*	*
5	H_2S	*	*
6	Suspended dust	*	*
7	Pb in dust	*	*
8	Meteorology	*	*
8.1	Rainfall	*	*
8.2	Wind	*	*
8.3	Temperature	*	*
8.4	Humidity	*	*
8.5	Evaporation	*	*
8.6	Radiation	*	*

Legend: Wind monitoring include velocity and direction.
Rain monitoring include volume per day

Air and dust samples are collected and analyzed once per month, with frequency of 3 days, 6 samples per day. At each monitoring location measuring will be carried out 3 days continuously with total of 54 samples for each indicator. These indicators will be analyzed according to Vietnamese standard and International Standards.

Air monitoring methods applied in the report will be pursuant to Vietnamese Standard TCVN-1995 and if this standard is inadequate, the American Standard is proposed (American Public Health Association). Methods of Air Sampling and Analysis- Second edition do APHA-USA (American Public Health Association).

Limits of Common Indicator of Ambient Air (mg/m^3)

n	Indicator	Average	Average	Average	Vietnamese
		1 hour	8 hours	24 hours	Standard – 1995
1	CO	40	10	5	TCVN – 5937
2	NO_2	0.4	-	0.1	TCVN – 5937
3	SO_2	0.5	-	0.3	TCVN – 5937
4	H_2S	0.008	-	0.008	TCVN – 5938
5	Pb	-	-	0.005	TCVN – 5937
6	Suspended dust	0.3	-	0.2	TCVN – 5937

C.3.7.4 Water Quality Monitoring

The main function of this monitoring is to monitor discharge of treated wastewater to Lach Tray River and monitoring of changes in velocity and directions of flow. Monitoring of wastewater treatment process in Vinh Niem WWTP and water quality of the Lach Tray River will be carried out continuously, whereas in other places monitoring activities are needed only during construction period.

C.3.7.4.1 Wastewater and Surface Water Monitoring

1. Raw wastewater
2. Effluent before discharging to the Lach Tray River
3. Lach Tray River at the upstream and downstream of discharge point

Monitoring Frequency and Indicator of Wastewater

Group	Indicator	Sampling frequency			VN Standard
		One/week	One/month	One/quater	5945 – 1995
I	Physical indicator				
	Temperature	*			40^0C
	PH	*			6 - 9
	SS	*			50 mg/l
II	Oxygen indicator				
	BOD_5		*		2.0 mg/l
	COD		*		50 mg/l
III	Nutrients				
	Organic P		*	*	0.2 mg/l
	Total N		*		
	Total P		*		
	Ammoniac (N)		*	*	0.1 mg/l
IV	Chemical indicator				
	Chloride		*		1.0 mg/l
	Fluoride			*	1.0 mg/l
	Sulfate			*	0.2 mg/l
	Phenol			*	0.001 mg/l
	Oil			*	KPH§
	Tetracloetylen			*	0.02 mg/l
	Tricloetylen			*	0.05 mg/l
V	Heavy metal				
	Total Fe			*	1.0 mg/l
	As			*	0.05 mg/l
	Cd			*	0.01 mg/l
	Pb			*	0.1 mg/l
	Hg			*	0.005 mg/l
	$Cr^{(VI)}$			*	0.05 mg/l
	$Cr^{(III)}$			*	0.2 mg/l
	Mn			*	0.2 mg/l
	Zn			*	1.0 mg/l
	Cd			*	0.2 mg/l
VI	Biological indicator				
	Total Coliform		*		5000 MPN/100ml

Monitoring Frequency and Indicators of Surface Water Quality from Lac Tray River and Discharge Flow to Lac Tray river

Groups	Indicator	Sample frequency			TCVN5942-1995
		One/week	One/month	One/quarter	Column B
I	Physical indicator				
	Temperature		*		
	PH		*		5.5-9.0
	Total solid		*		80.0 mg/l
II	Oxygen indicator				
	Dissolved oxygen	*			≥ 2.0 mg/l
	BOD_5 (20)	*			< 25.0 mg/l
	COD	*			< 35.0 mg/l
III	Nutrients				
	Total N		*		
	Total P		*		
	PO_4-P		*		
	Ammoniac		*		1.0 mg/l

	Nitrate		*		15.0 mg/l
	Nitrite (according to N)		*		0.05 mg/l
IV	Chemical indicator				
	Total Phenol			*	0.002 mg/l
	Oil, grease			*	0.3mg/l
	Detergent			*	0.5 mg/l
V	Heavy metal				
	Total Fe			*	2.0 mg/l
	As			*	0.1 mg/l
	Cd			*	0.02 mg/l
	Pb			*	0.1 mg/l
	Hg			*	0.002 mg/l
	$Cr^{(VI)}$			*	0.05 mg/l
	$Cr^{(III)}$			*	1.0 mg/l
	Mn			*	0.8 mg/l
	Zn			*	2.0 mg/l
	Sn			*	1.0 mg/l
VI	Biological indicator				
	Total Coliform		*		5000 MPN/100ml
	Fecal. Coliform		*		-

The hydrological regime, changes of water level, flow velocity and direction, erosion and sedimentation of bank will be monitored upstream and downstream of discharging points in Lac Tray River.

C.3.7.4.2 Groundwater Monitoring

Groundwater monitoring will be done from two wells in the vicinity of Vinh Niem WWTP once per quarter.

Monitoring Frequency and Indicators of Groundwater

Items	Indicators	Frequency of monitoring			TCVN 5944-1995
				One/quarter	
I	Physical indicator				
	PH			*	6.5-8.5
	Color			*	5-50
	SS (mg/l)			*	750-1500
II	Nutrients				
	Ammonia			*	-
	Nitrate (mg/l)			*	45
III	Toxic indicator			*	
	Phenol (mg/l)			*	0.001
IV	Heavy metal				
	As (mg/l)			*	0.05
	Cd (mg/l)			*	0.01
	Pb (mg/l)			*	0.05
	$Cr^{(VI)}$ (mg/l)				0.05
	Cu (mg/l)			*	1.0
	Zn (mg/l)			*	5.0
	Mn (mg/l)			*	0.1-0.5
	Mercury (Hg) (mg/l)			*	0.001
	Total metal			*	-
V	Biological indicator				

	Total Coliform (MPN/100ml)				3
	Fecal Coliform (MPN/100ml)				-

C.3.7.5 Monitoring of Treatment Sludge

Samples will be taken from sludge drying bed and sludge in settling tank once per month.

Sludge Monitoring Indicators

no	Indicator for sludge monitoring	Unit	Monitoring frequency		
			Once/week	**Once/month**	**Once/quater**
1	PH		*		
2	Humidity	%	*		
3	Total P	mg/kg	*		
4	Total N	mg/kg	*		
5	Oil	mg/kg	*		
6	As	mg/kg	*		
7	Hg	mg/kg	*		
8	Cd	%	*		
9	Pb	%	*		
10	Cr	%	*		
11	Cu	%	*		
12	Ni	%	*		
13	Zn	%	*		
14	Mn	%	*		
17	SO_4	mg/kg	*		
18	Fe	mg/kg	*		

C.3.7.6 Other monitoring

Periodical monitoring and examination of sewer system are needed such as land subsidence, damage of dykes and conducting pipelines to Vinh Niem WWTP should be included to the normal operation and maintenance routines. The monitoring frequency is once per month.

- Condition of WWTP and sewer network
- Effluent discharging point
- Land subsidence, erosion, damage of dykes

C.3.7.7 Monitoring Cost

Type of Monitoring	VND / year	USD /year
Monitoring of Project Affecting People		
• Cost for questionnaire collection 12 x 15 questionnaire/day x 150,000 = 9,000,000 VND • Cost for information supplier 60 questionnaires x 15,000 VND = 900,000 VND • Health examination 2 times /year x 5,000,000 VND = 10,000,000 VND		
Sub-total	19,900,000	1,414
Air Quality monitoring		

• Cost for sample collection 4 locations x 12 times x 1,000,000 VND = 48,000,000 VND • Cost for sample analysis 4 locations x 54 samples x 7 indicators x 30,000 = 45,360,000 VND		
Sub-total	93,360,000	6,634
Water Quality Monitoring		
• Cost for sample taking Groundwater: 2 wells x 4 samples/year x 200,000 VND = 1,600,000 VND Wastewater and Surface water: 4 points x 48 sample/year x 100,000 VND = 19,200,000 VND • Cost for sample analysis 6 points x 52 samples/year x 400,000 VND = 124,800,000 VND		
Sub-total	144,000,000	10,233
Sludge Quality Monitoring		
Cost for sample taking 1 point x 12 samples /year x 100,000 VND = 1,200,000 VND Cost for analysis 1 point x 12 samples/year x 500,000 VND = 6,000,000 VND		
Sub-total	7,200,000	512
	264,460,000	**18,793**
Other Monitoring		
1 people /time x 12 times /year x 100,000 VND /per day = 1,200,000 VND	1,200,000	85

The total cost for environmental monitoring per year is 264,460,000 VND equivalent 18,793 USD.